TOPICS OF THE MONTH

Engineering and antibiotics

ELSEWHERE in this issue we briefly report some remarks of an eminent surgeon on medicine's debt to chemistry. The same subject has also been commented on from a different angle by Mr. John E. McKeen, president of Chas. Pfizer & Co. Inc.—the huge American firm of antibiotics manufacturers—who addressed a meeting of the British Association of Chemists in London on June 20. Mr. McKeen gave some figures which illustrate how enormous was the task of getting penicillin into mass production, and later how fantastic was the speed of growth. In 1941 there was just enough penicillin to allow treatment for six patients. In 1943, 29 lb. of the antibiotic had been laboriously harvested. Yet, by 1945, 14,000 lb. of pure penicillin were being produced and, 10 years later still, more than 765,000 lb. were being produced in America alone. Such figures, as Mr. McKeen points out, tell as plainly as any other way could how the industrial scientist came to enter the picture.

Mr. McKeen went on to pay tribute to the work of that new kind of industrial scientist—the biochemical engineer—who is part microbiologist, part chemist and part master mechanic, and who designed the gigantic fermentation systems on which the large-scale production of penicillin is based. As an example of the problems he has to solve, tiny amounts of copper useful to some fermentation processes are, for instance, toxic in penicillin fermentation. This factor represents a special headache for the biochemical engineer, and he must always make certain in designing a fermentation process that pipelines, tanks and associated equipment pose no hazard to the mould.

In his talk, Mr. McKeen also referred to the discovery of the potent new antibiotic, *Tetracyn* (tetracycline), the separation and purification of which challenged Pfizer's engineers with new problems in fluid flow, heat transfer, reaction kinetics and crystallisation. Despite this, they were able to move into full mass production only five months after its clinical value was established.

The production development of *Tetracyn* and the new steroid compounds represents a major development in pharmaceutical technology—the use of fermentation to accomplish otherwise impossible sequences in chemical synthesis.

Finally, Mr. McKeen pointed out that the drugs of a generation ago were essentially the products of the dye industry and were produced by the classical manufacturing methods of that industry. Drugs today, such as the broad-spectrum antibiotics, biologicals and cortical hormones, have required new manufacturing techniques and new chemical engineering concepts. Because of their unusual complexity, the production of these drugs has been responsible for radical innovations within the field of industrial chemistry. 'And,' he concluded, ' we are prepared to supplant them tomorrow with still other scientific and technological innovations, as they are required, in the continuing service of medicine and for the benefit of all mankind.'

Ten years of Harwell

A SERIES of ' Open Days ' was held at the Atomic Energy Research Establishment at Harwell recently, to mark the passing of the first ten years since its foundation, and a tour of the establishment was made all the more interesting by the announcement, a few days earlier, that the first of the two atomic piles in the Calder Hall power station—which will be the first in the world to supply electricity on a large scale from nuclear sources—had started working.

As a result of the changes in security classification, much of the work at the establishment is no longer subject to security restrictions. Consequently visitors had more freedom to see a wider range of work at Harwell than was possible until recently.

The work of Harwell covers a wide field and, within one division alone, such as the Chemical Engineering Division, a great variety of projects are under way. One important task is the study of new methods of processing irradiated fuel elements, and the problem of cutting out the expensive step of converting the solution back to the metal is engaging much attention. As well as investigations of processing problems connected with solid-fuel elements, those concerned with the homogeneous aqueous reactor system were also demonstrated. Some interesting uranium extraction columns were also seen in this building, and one could compare the bubble size obtained in a pulsed and unpulsed column. A pulsed column will achieve the same separation as an unpulsed column two or three times as long.

An understanding of the processes involved in the dissolution of solid metals in liquid metals is of considerable importance in combating corrosion in liquid metal coolant channels. Of the liquid metals, sodium is of chief interest at present, but other metals, such as bismuth, also have some appeal. For *ad hoc* work, mercury is the most convenient. A specimen of solid metal is rotated in a pot of liquid metal, the concentration of solid metal in the liquid being afterwards measured. An interesting item of apparatus is a molten bismuth loop used to study the effect of flow rate on the corrosion of various metals. Circulation is provided by means of a nitrogen gas lift pump. A dynamic corrosion-test circuit is used to investigate the effects of fluid flow and sodium temperature gradients on the corrosion of small specimens.

These activities form only a fraction of the technological work at Harwell, where about 20% of the staff, in addition, work on fundamental research tools such as the cyclotron and linear accelerators as well as facilities for work in radiochemistry, solid-state physics and theoretical physics.

A misunderstood word

A TIMELY comment on some of the more romantic notions about 'Automation,' made by Sir Alexander Fleck, K.B.E., D.SC., LL.D., F.R.S., chairman of Imperial Chemical Industries Ltd., echoes the feelings of many in the chemical industry about this subject. In his speech at the company's annual general meeting, he pointed out that, although the word is new, the ideas behind it are not. With full employment, it is self-evident that any broad advance in standards of living must depend upon a reduction in human effort relative to the results achieved. In general, this can only come by applying new methods, of which electronic equipment and servomechanisms are recent examples. 'I stress again, therefore,' Sir Alexander continued, 'that automation is not new, but merely the continuing extension of a process which has for long been a normal feature of our operations. In our industry, we certainly do not regard these changes as revolutionary, nor do we think they are likely to cause unemployment or other major difficulties.' Sir Alexander went further, and said that employment will only be maintained if British industry keeps abreast of the world in technical efficiency. This means not only the extension of automation but continued heavy capital expenditure.

A new journal, *Automation Progress*, is being published by Leonard Hill Ltd. for the benefit of those who want to keep informed about developments in this field.

Improved chlorine dioxide generation

AN improvement in the process for generation of chlorine dioxide for pulp bleaching, which may mean mill savings in the order of $6,000 to $8,000 a year per ton day of the gas produced, has been developed by Olin Mathieson Chemical Corporation in the United States.

Under present practice chlorine dioxide is generated at the mill site by reduction of sodium chlorate with sulphur dioxide or methanol in an acid medium. The Olin Mathieson improvement involves the simple step of introducing sodium chloride (common salt) into the reaction mixture in the ratio of 0.06 to 0.08 lb. per pound of sodium chlorate. This procedure results in almost quantitative reduction of sodium chlorate to chlorine dioxide, compared with yields of about 90% obtained at present. It also produces chlorine dioxide of improved quality in that the free chlorine in the gas stream is usually less than 1.5% compared with 2 to 5% currently common.

The development is the subject of a patent application naming W. W. Northgraves and B. H. Nicolaisen of Olin Mathieson as the inventors. According to Mr. Northgraves, existing chlorine dioxide generator installations can easily be adapted to the addition of sodium chloride by adding a salt make-up tank and making necessary piping changes. This can be done at very nominal cost, he said.

It is stated that, while the experimental work was done with sulphur dioxide as the reducing agent, sodium chloride addition can be expected to be equally effective where other reducing agents are used. Current theories of reaction mechanism indicate that the actual chlorine dioxide-forming reactions are independent of the reducing agent used and there is, therefore, no doubt that sodium chloride addition will have similar beneficial effects in the methanol process or any other process which is operated in a sulphuric acid medium.

The process improvement was developed in a continuous bench-scale pilot plant in the Olin Mathieson research laboratories at Niagara Falls, New York, and has been proven on a plant scale in actual mill operation. An increase in efficiency of 7 to 8% was demonstrated in the laboratory and 5 to 6% in the plant.

New cement-making process

OPENING of a pilot plant for testing and demonstrating a new process for making cement has been announced in the U.S. by the Allis-Chalmers Manufacturing Co. The plant is at the company's heat-processing laboratory in Carrolville, Wisconsin.

The new process is said to result in considerable savings in fuel and the recovery of dust. Allis engineers estimate that the system could save between $100,000 and $200,000 a year in fuel costs for cement plants with an annual capacity of 1 million to 1,300,000 barrels.

Another advantage mentioned is that the process, which uses a short kiln, takes up only a little more than half the space needed for conventional cement manufacturing. Allis plans to build the first full-scale plant to produce this new cement near Milwaukee.

Two-stage 'cat cracker' yields more gasoline

A NEW oil-refining process that gets more gasoline out of crude oil has recently come into operation at Shell Oil Co.'s new Anacortes refinery in Washington, U.S. The development—a two-stage catalytic cracker—increases the yield of gasoline from crude oil up to 15%. At the same time it raises efficiency and thus helps keep down the rising costs of refining.

In ordinary catalytic cracking, oil goes through the cracking unit only once, but in this single passage some of the oil is cracked too much—into molecules too light for gasoline—and some is not cracked enough. The two-stage process prevents overcracking and undercracking and thus produces more gasoline. In the first stage, hot catalyst strikes oil for a short time, causing it to vaporise and begin to crack. This partially cracked oil then goes through a separating system which removes gasoline and gas formed in the first stage. The remaining uncracked oil goes on to the second-stage reactor.

The second stage is a conventional process employed by standard 'cat crackers.' It lasts longer than the first stage and is conducted at lower temperatures.

Beside high gasoline yields, the two-stage cracking system has resulted in lower coke yields and greater flexibility than conventional methods.

83-ton steam boiler

THE chemical engineering industry is well used to transporting heavy and awkward loads by road, and one cannot help marvelling at the patience and ingenuity of those who engage in this nerve-racking and exasperating game. However, when one hears of a load which has to move at night under a police escort one cannot escape a feeling that beyond a certain size an item of plant abandons all respectable proportions and enters the criminal classes!

But so it was with a boiler of exceptional dimensions which recently arrived at the N.V. Chemische Fabriek 'Naarden' in Holland to augment the existing installations. It weighs no less than 83 tons—excluding all the accessories—and is 5.20 m. (slightly more than 17 ft.) in diameter. It has an hourly capacity of 9,000 to 10,000 kg. of steam, to produce which approximately 800 l. (176 gal.) of fuel oil are required.

With three others, this Scottish boiler was originally installed in a British steamship. The other three are now in use in Dutch whalers.

This huge boiler was transported to its destination *via* Lake IJssel (the former Zuyder Zee), where heavy winds held up the freighter for two days. It then passed through the Amsterdam-Rhine Canal, where one of the largest floating cranes in the Netherlands ('Jumbo,' 160 tons) was waiting to lift it on to a trailer. This was done at dead of night with the aid of a whole battery of searchlights. The trailer used for this mighty haul ran on no fewer than 32 wheels and was drawn by a truck fitted with 13 gears. Only 14 km. (nearly nine miles) separated it from its final destination, but such were the overall dimensions that the route had to be closed to all other traffic. Hence the need to move it at night under a police escort.

In spite of the route having been chosen extremely carefully, several trees lining the roads still bear tangible witness to the passage of the boiler. The 'giant' finally arrived at its ultimate destination (carrying part of the porter's lodge with it!) in the early hours of the morning. It is hoped that the new boiler—the fourth in 'Naarden's' boiler-house—can be taken into service at the beginning of November.

A photograph of the boiler appears on another page.

Comical Engineering Situations

"AN INTERESTING DISCOVERY, I ADMIT, WILKINS, BUT I FAIL TO SEE ANY PRACTICAL COMMERCIAL FUTURE FOR IT"

Putting textiles to work

THE chemical engineer perhaps more than any other finds that the consideration of materials of all kinds plays an important part in his work. Today he finds himself increasingly adding to his list of materials of construction. With some materials, such as plastics, their appearance in his field has been sudden and dramatic; while others, such as some of the newer metal alloys, have proved their worth by the slow but sure means of trial and error. And now we find that among the materials which have crept up almost unnoticed are textiles, the industrial uses of which are growing at a tremendous rate. In the chemical engineering field, among examples which spring to mind are the use of newer, acid- and heat-resistant fibres for filter cloths, conveyor belting and protective clothing, while fibre-reinforced plastics open up a completely new field of uses.

In the United Kingdom, some 30% of the viscose rayon spun is used for industrial purposes and in the United States the proportion is very much higher. Everywhere in industry one finds a growing interest in these special materials. Because of this there is a need for some form of liaison between the producers of industrial textiles and the industries for which they are designed. This will now be provided by a new journal called *Textiles in Industry* which has been launched by Leonard Hill Ltd.—publishers of CHEMICAL & PROCESS ENGINEERING and 12 other monthly technical journals, including the well-known and established *Fibres—Engineering and Chemistry*. Each month its editorial pages include news and views on the many industrial textiles available today, as a guide to the hundreds of industries using them. The June issue of *Textiles in Industry*, for example, included an article on a new type of monofil of polythene, another on a new method of improving the resistance of low-pressure, glass-reinforced laminates to chemicals and abrasion, while other articles deal with the use of rayon staple in overall fabrics, a machine for producing a better bonded fabric, the application of latex rubber to textiles, the use of textiles in conveyor belts, hoses, etc., and a report on *Terylene* fibre.

Further particulars about *Textiles in Industry* can be obtained from the publishers at Stratford House, Eden Street, London, N.W.1.

India to step up mining operations

DESPITE the good work done in investigating ore-dressing techniques in India (the subject of an article in this issue), all is not as it should be with India's mining industry in the eyes of its Government. So, at least, one would judge from a recent statement of Mr. K. D. Malaviya, India's Minister for Natural Resources, who expressed dissatisfaction with the progress of production of lead and zinc ores from the Zewar mines in Rajasthan, and hoped that it would reach 500 tons/day by the end of July and 1,000 tons in another 18 months' time.

Mr. Malaviya revealed that the Indian Copper Corporation at Ghatsila is at present producing between 6,000 and 7,000 tons of metal p.a., while other deposits in Sikkim, Daribo and Khetri are under investigation. The Government, however, propose to take suitable measures in the next two or three years to step up production either in one or all of these places. There are also several schemes in this connection which are being considered by the Government, who are making preparations for completing the investigation of Khetri and other copper mines.

India's mica industry is facing difficulties owing to a fall in the overseas demand, which has been attributed to the suspension or cessation of the stock-piling programme of foreign countries and the increased utilisation of substitutes. There has also been a fall in prices. To facilitate export of mica, Government action has been taken to set up an Export Promotion Council which would study the market conditions in foreign countries and explore the possibility of locating fresh markets. Mr. Malaviya said it was also desirable that internal utilisation of mica should be stepped up and he wanted the research institutions of the Council of Scientific and Industrial Research to render the requisite assistance.

New U.S. steel processes

THE U.S. steel industry's new oxygen process to produce high-quality carbon steel more quickly and cheaply has emerged from its trial runs with excellent results, according to the American Iron and Steel Institute in New York. More than 2 million tons of steel were produced during the runs. The Institute said the oxygen steel-making vessels could produce steel at the rate of more than 50 tons/hr., as against 20 to 25 tons for modern open-hearth furnaces.

Operating costs were substantially lower and the quality of the steel produced was comparable, for many purposes, to that produced by the open-hearth method. The Institute said that oxygen converters would be installed gradually at first to complement existing steel furnaces, but, if operating experience remained favourable, steel producers would add them wherever they could be most efficiently employed.

In Pittsburg, the U.S. Steel Corporation has confirmed plans for the first major utilisation of oxygen in its steel-making process, and has announced that a large oxygen plant will be built at its Duquesne works, the product to be utilised in blast furnaces producing ferro-manganese.

At the same works, an airtight chamber—the first in the United States—for vacuum castings of large forging ingots is being put into operation. A spokesman for the company said the chamber was expected to improve the quality of the steel in larger ingots by reducing the amount of trapped gases. This, he said, would eliminate the small hidden defects which were sometimes present in ingots poured by conventional methods.

Round-up of Canadian chemical projects

CANADA'S chemical industries continue to develop on a broad front. Much of the expansion is linked with the growth of the mineral and forest products industries: a $5-million explosives plant at North Bay; the first Canadian production of xanthates for metal refining; the expansion of soda ash capacity to a point capable of meeting all Canadian demand; the trebling of the capacity of the Cornwall plant of the leading Canadian producer of chlorine, muriatic acid, and caustic soda; the first Canadian production of liquid aluminium sulphate for use in the manufacture of pulp and paper; an $11-million plant in British Columbia to produce chlorine and caustic soda, and a new $5-million sodium chlorate plant in North Vancouver—both to supply the pulp and paper industry; and a new $9-million plant at Millhaven to produce 200 tons/day of ammonia.

The expansion of refineries has led to the establishment of a $12-million plant for Canada's first production of tetraethyl lead; synthetic fluid cracking catalysts are also to be produced for the first time in Canada, and a $6-million plant is being set up to produce sodium silicates mainly, for use in the catalyst plant.

The petrochemical industry is also expanding: a leading producer at Sarnia has a $10-million expansion programme which includes an additional ethylene plant, an enlargement of the existing glycol plant, and a new plant to produce pentachlorophenol; the Crown Corporation which produces synthetic rubber is to spend $3 million to cover the initial cost of a new butadiene unit. Products of the petrochemical industry now (or shortly to be) in production for the first time in Canada include methyl ethyl ketone, secondary butyl alcohol, isopropanol, methyl isobutyl ketone and dodecyl benzine. The processing of natural gas is leading to another round of development in the Prairies; work has begun at Pincher Creek on a plant which is to produce 225 tons of sulphur daily, which will be used largely in a new $25-million plant at Medicine Hat for the production of high nitrogen and phosphate fertiliser. A synthetic fertiliser plant, also using natural gas, is to be built near Winnipeg with a daily capacity of 600 tons of mixed fertiliser, including 80 tons of fixed nitrogen. An $18-million plant is planned in the Peace River area to process about 300 million cu. ft. of natural gas daily, removing the bulk of the liquid hydrocarbons and virtually all the sulphur before delivery to the west coast pipeline.

CRYSTALLISATION

Crystal growth and structure; new crystallising apparatus; sugar industry advances; nitrogenous salts, etc.

Crystal growth

EQUATIONS for the rate of crystal growth in the region of pure molecule diffusion in supersaturated solutions have been derived by Litunovskii and Todes,[36] and Krishtal[34] has attempted to verify experimentally the theory of crystal growth in which the rate of growth is related to the temperature of crystallisation.

Factors involved in the speed of crystallisation have been described by Chretien *et al.*[11] They find the velocity of crystallisation depends upon diffusion, the total surface of the seeds, the number of seeds and their granulation and, finally, the square of the supersaturation expressed in degrees. Rastogi and Chatterji[53] have investigated the kinetics of phase transformation in supercooled solutions and an attempt is made to explain the results using Frenkels' theory of two-dimensional crystallisation velocity. The speed of crystallisation of salol (phenyl salicylate) degassed *in vacuo* has been measured by Neumann and Micus.[47] Sadovyi[56] has described the relationship of the rate of crystallisation of glucose to basic physical factors.

The growth velocity of single faces of hexamethylenetetramine crystals from the vapour phase has been measured at constant temperature and supersaturation by Honigmann and Heyer.[28]

Experiments by Morris and Strickland-Constable[46] on the rate of crystal growth from a melt of benzophenone indicate that the rate of growth of individual faces remains constant. Microthermal analyses carried out by Kofler[33] indicate that solidification and melting of many mixed crystals is a step-wise rather than a continuous process. Correns[13] has discussed the stability of crystal nuclei in superheated melts and undersaturated solutions.

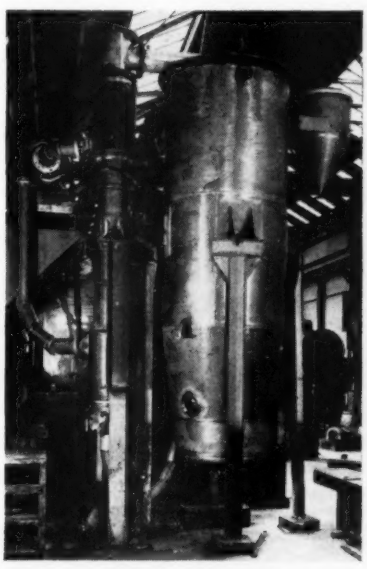
Gopal[25] has investigated spontaneous crystallisation in supersaturated solutions and undercooled melts. The conclusion, derived theoretically as well as from experimental results, is that spontaneous crystallisation occurs at temperatures favouring approximately equal free-energy changes.

$MgSO_4.7H_2O$, $BeSO_4.4H_2O$ and $UOSO_4.3H_2O$ were crystallised from metastable and labile solutions and the crystals studied crystallo-optically and thermographically.[26] In the case of the substances examined, the difference in the optical properties and thermograms between crystals from metastable solutions and crystals from labile solutions increases with the more difficult crystallising salts.

Papers read at the internal conference of the Crystallisation Committee on March 8, 1955, at Bad Hamburg have been reported.[10] The subjects dealt with are crystal growth as a molecular phenomenon, the rounded growth of single-crystal specimens produced by the Verneuil process, crystal growth from the vapour phase, hydrothermal crystal growth, crystallisation in the sugar industry and crystal growth problems of white pigments with reference to lithopone.

Crystal shape

The problem of crystal shape and its industrial importance is the subject of an article by H. Seifert.[59] In it he discusses the basic principles of crystal structure, changes in shape and their causes, uniformity of grain size, problems in nucleation, $(NH_4)_2SO_4$ crystallisation, effect of purity upon crystallisation, storage and caking problems and crystallisation from the vapour phase.



Stainless-steel 'Krystal' cooling crystalliser for production of silver nitrate crystals.

Arakawa[2] has shown, with the aid of shadow photographs, the steps in the growth of disc crystals and dendrites of ice; he argues that dendritic growth is probably due to mechanical stresses in the crystal. Glenn[24] has commented on Arakawa's paper and suggests that dendritic growth occurs after the disc crystals have attained a size such that the loss of latent heat is rendered difficult.

Gahm and Nacken[23] have discussed the formation of skeleton crystals of alkali halides with special regard to NaCl. They find that dendrites, needles and stalactites of the above result from the selection of ions and atoms, due to temperature gradients, the effects of diffusion and energetically favouring of particular lattice forms.

Effect of additions

Misumi *et al.*[44] have described the effect of adding ammonium carbonate, ammonium bicarbonate, glucose and lactose or sucrose to a solution of ammonium chloride saturated at 40°, and Mircev and Sandera[43] have performed a series of experiments to investigate the effect of Na_2SO_3, $CaCl_2$, NaOH, $Ca(NO_3)_2$ and $Al(SO_4)_3$ on raw sucrose yield.

The improvement in the properties of ammonium nitrate obtained by the addition of inorganic salts has been described by Dubovitskii *et al.*[18] They find that the addition of $Mg(NO_3)_2$ or $Mg(NO_3)_2$ — $Ca(NO_3)_2$ to NH_4NO_3 favours the formation of dendritic crystals and thereby reduces the tendency of the crystallised salt to cake. Enoksson and Enoksson[19] have patented a method of reducing the tendency to lump formation in NH_4NO_3 by the addition of 0.005 to 5% of an alkyl sulphate, alkyl sulphonate, alkyl-aryl sulphonate or alkyl phosphate

containing 8 to 30 C.atoms/mol with no less than four of these in an aliphatic chain. According to Nylander,[48] the treatment of NH_4NO_3 with 0.01 to 5% Na polymetaphosphate results in a product free from the tendency to form hard lumps on storage.

The effect of boric acid on the growth of ethylenediamine tartrate crystals has been described by Booth and Buckley.[5] Crystallographic phenomena were produced which are associated with adsorption and which are typical of crystal growth 'improvers,' the most important being: changes in crystal habit; decrease in growth rate as compared with pure solutions; and extension of the metastable range of supersaturation.

Moriyama and Yawataya[45] have measured the rate of crystal growth of ammonium chloride in the presence of NaCl, NH_3 and $NaHCO_3$. They find that NaCl has little effect, but that $NaHCO_3$ or NH_3 greatly inhibit the crystal growth.

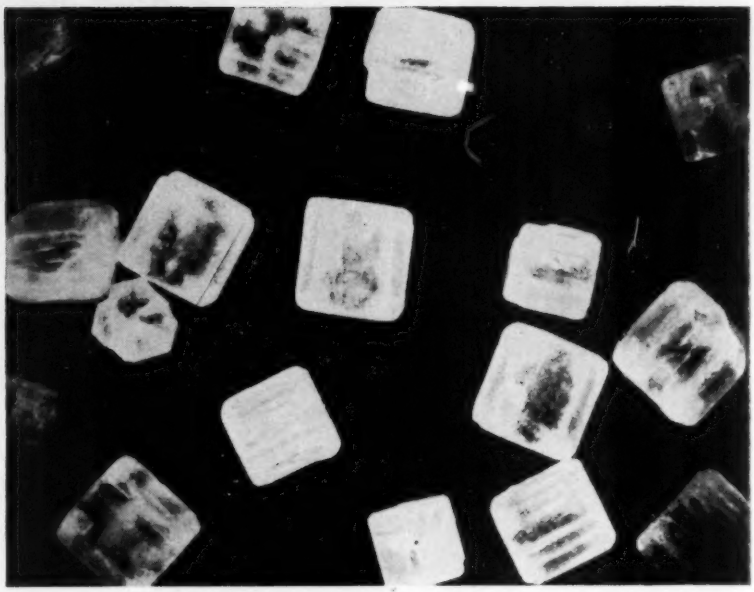
Milone and Cetini[41] have made an investigation into the relations between surface tension and crystal habit. They describe, with the help of photographs, the growth of K alum crystals from a supersaturated solution containing *Leonil-S* (a surface-active agent). Their work indicates that the *Leonil-S* is adsorbed preferentially by those crystal faces that are not formed under normal conditions. Palermo *et al.*[52] have written a comprehensive review dealing with nucleation and growth, additives affecting crystallisation, oriented overgrowth, industrial practice and equipment for crystallisation. Seventy-five references are given.

Crystallisation apparatus

Saeman[57] has discussed the problem of crystal size control in vacuum crystallisers with especial reference to the Oslo-Krystal crystalliser evaporator, the design of which most strongly emphasises means for size control by the segregation and removal of excess fines.

Varlamov and Starosel'skii[66] have described apparatus capable of producing crystals of nitrosylsulphuric acid of a definite composition and with a predetermined H_2SO_4 and N_2O_3 content.

Ottosson[20] has invented a crystalliser which is suitable for growing large piezoelectric or optical crystals. A crystallising device for the production of piezoelectric crystals, in which the mother liquor is rendered supersaturated by recirculation through a recharging apparatus containing solid material, has been developed by Dauncey and Still.[15]



Sugar crystals of ammonium sulphate (Magnification x 5).

Rush[55] has taken out a patent on a continuous centrifugal crystal purifier, which is claimed to be suitable for the separation of isomers otherwise difficult to separate.

Matz[39] has written a review of crystallisers, outlining basic principles and discussing cooling, evaporative, vacuum and classifying crystalliser types.

Findlay[21] has patented a device for obtaining organic crystals of 99+% purity from a binary or multicomponent eutectic-forming liquid mixture. The process is said to be particularly useful for the separation of compounds with similar physical properties, such as boiling points and solubilities.

Kienitz[32] has described apparatus for the purification of organic substances by the method of fractional crystallisation. Curves illustrating the method used are provided for the case of benzene.

Apparatus suitable for the crystallisation of milligram quantities of organic compounds has been described by Wright.[68] Solvent may be added to a range of 1 to 100 mg. of material and subsequent filtration can be carried out without loss of any part of the mixture.

Apparatus in the form of a mixer crystalliser has been described in a patent.[50] It is claimed that the equipment which incorporates a cooling circulation within the agitating structure gives a higher and more rapid yield of crystals from massecuite.

Coats[12] has patented a scheme which prevents the deposition of *p*-xylene on the cooling coils used in its separation by crystallisation from a cooled mixture of xylenes. The coil is made part of a high-amperage circuit and is heated periodically for short intervals by passing an electric current. The effect is to melt deposits of *p*-xylene on the coil without there being a substantial heat loss to the cooling fluid or to the mother liquor.

The use of resinous organic coatings for handling equipment for wet ammonium bicarbonate crystals is described in a patent.[6] In particular the problem of 'hang up' in feeder chutes and valve mechanisms is avoided. Several compounds suitable as surfaces for conveyors and metal feeder chutes, etc., are given.

Johnson and Newman[30] have discovered a two-sieve procedure permitting the rapid determination of average grain size and uniformity of crystal products. Two methods for calibrating the sieves for effective openings are given.

Ceni[8] has patented a method of refrigerating a solution to crystallise out the solvent or to remove impurities that will solidify on a decrease in temperature.

Vicaire[67] has described how crystal models correct to within 1° can be prepared from casting materials such as plaster and cement. The moulding

Rice crystals of ammonium sulphate (Magnification x 10).

or extrusion of plastic materials is also described.

Sugar industry

Ludecke[37] has discussed the valuation of the purified sugar yield from the point of view of sugar loss on crystallisation due to soluble ash and harmful nitrogen.

A process for raw sugar recovery from green syrups, without reboiling, using crystallisation at 60° for a period of 12 to 14 hr., has been described by Mircev.[42]

Tonn[65] has written a review of recent papers on heat exchange with particular reference to evaporation in the sugar industry.

The effect of adding CO^{++} to a 60% sucrose solution has been examined by Suzuki.[63] Compared with Mn^{++}, CO^{++} on its own has a less beneficial effect on the crystal yield and growth, but the addition of 5×10^{-4}% $CuSO_4$ and 5×10^{-5}% $MnSO_4$ increases the sucrose yield by approximately 11%.

Baudelocque[4] has discussed the distribution of impurities in raw sugar crystals. Of the ash present, 40 to 50% occurs on the surface of the crystal and a simple washing can remove most of this. Ordinary washing in the centrifuge is generally imperfect.

In experiments carried out by Makower and Dye[38] amorphous sucrose and glucose powders were subjected to relative humidities ranging from 4.6 to 33.6% at 25°. Moisture equilibrium was attained at humidities lower than 12% and 5%, respectively, and very little crystallisation occurred in nearly three years. At humidities higher than these, crystallisation was initiated by the absorbed moisture with the production of essentially anhydrous sugar crystals.

Nitrogenous salts

Yoshimura and Maruoka[69] have described a method of separating ammonium sulphate from sulphonated mineral-oil sludge. The sludge is taken up in 10 times its weight of MeOH and then saturated with NH_3 gas at a temperature less than 30°; $(NH_4)_2SO_4$ crystallises out and the crude crystals, after filtration, are washed with petrol ether to remove any residual neutral oil. The washed crystals are taken up in fresh MeOH, which is then removed, and the residue is dissolved in water to separate a small amount of pitch which remains. Evaporation of the aqueous solution gives a 40% yield of $(NH_4)_2SO_4$. The application of the *Krystal* crystalliser to the recovery of ammonium sulphate from petroleum refinery acid sludge and ammonia has been previously reported.[3]

The Stengel, prilling and vacuum crystalliser processes for the production of ammonium nitrate have been compared with the aid of flow sheets.[1]

A method of preparing coarse crystals of ammonium sulphate has been described.[62] Sulphuric acid and steam containing NH_3 are contacted in a saturator. The resulting crystals of ammonium sulphate are withdrawn and dewatered in a centrifuge. Crystals remaining in the saturator may be removed by dissolving them in recirculated mother liquor which has been reheated.

Brushtien[7] has suggested several ways of improving the design of granulating towers for NH_4NO_3.

Dorsey[16] has described a plant for the manufacture of NH_4NO_3 by the Stengel process. Costs and flow sheets are included.

Seshadri and Gupta[60] have proposed that $MgSO_4$, a by-product of the NaCl industry, can act as a substitute for gypsum in the fixation of NH_3. CO_2 and NH_3 are reacted with a saturated solution of $MgSO_4$ in the presence of KCl in an extension of the process for the production of a mixed Na-K fertiliser from sea bitterns. $(NH_4)_2SO_4$ of 96% purity may be obtained in a single crystallisation. $MgSO_4$ which has not reacted may be crystallised as $MgSO_4.(NH_4)_2SO_4.6H_2O$, which is itself a fertiliser.

The manufacture of urea by the Pechiney synthetic urea process has been described.[9] For plastics use where a high-purity product is required, the urea is crystallised at 80 to 100°F. in a *Krystal* crystalliser.

Miscellaneous

Crystallisation in the system B_2O_3—BeO—Li_2O has been studied by Mazalev.[40] The areas of vitrification and crystallisation are outlined and optical characteristics and photomicrographs are given.

Solubility data at 20° and 60° have been determined by Labash and Lusby[35] for the ternary systems: NaCl—NH_4Cl—H_2O; NH_4Cl—$(NH_4)_2SO_3$—H_2O; Na_2SO_3 — $(NH_4)_2SO_3$ — H_2O; NaCl—Na_2SO_3 — H_2O. Solubility isotherms are published of the systems Na_2SO_4—Na_2CO—H_2O; and K_2SO_4—K_2CO_3—H_2O by Itkina and Kokhova,[29] who have determined solubility isotherms at 70° and 200° of the system Na_2SO_4—NaOH—H_2O. Solubility data is also available for the systems: KnO_3—$(NH_4)_2NO_3$—H_2O at 25°C.;[31] LiCl—Li_2SO_4—H_2O at 25°C.;[17] KCl—K_2SO_4—H_2O;[61] and CrF_3—KF—H_2O at 25°C.[64]

The temperatures of crystal formation from saturated solutions of KCl and $CuSO_4$ as function of the rate of cooling have been determined.[27]

Oda[49] has patented a scheme for the production of $(NH_4)_2SO_4$ and $NaHCO_3$ using Glauber salt ($Na_2SO_4.10H_2O$) as a raw material.

The crystallisation of high polymers has been reviewed by Schuur,[58] 101 references being given.

A scheme for the recovery of sodium sulphate from viscose liquor has been patented.[22] Recovery is by fractional crystallisation of the concentrated mother liquor and optimum conditions, determined from the H_2O—H_2SO_4—Na_2SO_4 phase diagram, are described.

Roberts[54] has described the production of anhydrous sodium sulphate in the Cornwall Ontario plant of Courtaulds Ltd. The slurry obtained on melting Glauber salt is circulated between a settling tank and an evaporator. Concentrated slurry from the settling tank is filtered on a rotary filter and hot air is blown through the filter cake to give anhydrous Na_2SO_4.

Osugi[51] has patented a method for the recovery of sodium acetate from the waste liquor produced during the saponification of polyvinyl acetate. The treatment of liquors for the recovery of potassium and magnesium salts has also been patented.[14]

Acknowledgment

This review has been prepared by the *Krystal* department of the Power-Gas Corporation Ltd. (Chemical Plant Division) to which company thanks are due for permission to publish it.

REFERENCES

[1]Anon., *Chem. Eng.*, 1955, **62,** 320-323.
[2]K. Arakawa (Hokkaido Univ., Sappora), *J. Glaciol*, 1955, **2,** 463-468.
[3]A. W. Bamforth, CHEMICAL & PROCESS ENGINEERING, 1953, **34,** 171-174.
[4]A. Baudelocque, *La sucr. belge*, 1955, **74,** 217-220.
[5]A. H. Booth and H. E. Buckley, *Can. J. Chem.*, 1955, **33,** 1162-1165.
[6]C. C. Brumbaugh and R. A. Springer (to Diamond Alkali Co.), U.S. Pat. 2,693,403, Nov. 2, 1954.
[7]A. I. Brushtein, *Khim. Prom.*, 1954, 200-203.
[8]A. Ceni, Ital. Pat. 476,119, Nov. 28, 1952.
[9]*Chem. Eng.*, 1955, **62,** 320-323.
[10]*Chem.-Ing.-Tech.*, 1955, **27,** 320-322.
[11]A. Chrétien, J. Heubel and P. Trimolé, *Compt. rend.*, 1954, **239,** 814-816; *H.E.B.D. des Seances de l'Academie des Sciences.*
[12]R. R. Coats (to Imperial Chemical Industries Ltd.), U.S. Pat. 2,701,266, Feb. 1, 1955.
[13]C. W. Correns, Nachr. Akad. Wiss. Gottingen, Math-physik. Kl., IIA, *Math.-physik.-chem. Abt.*, 1953, 129-133.
[14]W. B. Dancy and R. A. MacDonald (to International Minerals & Chemical Corp.), U.S. Pat. 2,687,339, Aug. 24, 1954.
[15]A. L. Dauncey and J. E. Still (to General Electric Co. Ltd.), U.S. Pat. 2,721,209, Oct. 18, 1955.
[16]J. J. Dorsey, *Ind. Eng. Chem.*, 1955, **47,** 11-17.
[17]I. G. Druzhinin and A. P. Yanko, *Doklady Akad. Nauk. S.S.S.R.*, 1954, **94,** 481-483.
[18]A. M. Dubovitskii, F. G. Margolis and T. V. Glazova, *Khim. Prom.*, 1954 93-94.
[19]F. C. Enoksson and B. P. Enoksson (to Nitroglycerin A.B.), Swed. Pat. 146,308, July 27, 1954.
[20]L. M. Ericsson, Telefonaktiebolaget (O. L. Ottosson, inventor), Ger. Pat. 841,440, June 16, 1952. See also U.S. Pat. 2,683,080.
[21]R. A. Findlay (to Phillips Petroleum Co.), U.S. Pat. 2,683,178, July 6, 1954.
[22]France Rayonne (G. Derangère, inventor), French Pat. 984,598, July 9, 1951.
[23]J. Gahm and R. Nacken, *Neues Jahrb. Mineral, Abhandl.*, 1954, **86,** 309-364.
[24]G. J. W. Glenn, *J. Claciol*, 1955, **2,** 483.
[25]R. Gopal, Z. *anorg. u. allgem. Chem.*, 1955, **278,** 46-52.
[26]B. E. Gordon and A. M. Denisov, *Ukrain. Khim. Zhur.*, 1953, **19,** 368-371.
[27]Y. Hirano, Y. Suzuki and S. Otsuki, *Kagaku*, 1955, **25,** 256-257.
[28]B. Honigmann and H. Heyer, Z. *Krist.*, 1955, **106,** 199-212.
[29]L. S. Itkina and V. F. Kokhova, *Izvest. Sektora Fiz-Khim. Anal. Inst. Obshchei i Neorg. Khim. Akad. Nauk S.S.S.R.*, 1955, **26,** 242-247.
[30]J. R. Johnson and J. S. Newman, *Anal. Chem.*, 1954, **26,** 1843-1846.

View of interior of vessel illustrating the highly polished surfaces which are a feature of the 'Krystal' process.

[31]A. S. Karnaukhov and O. S. Zotova, *Doklady Akad. Nauk S.S.S.R.*, 1953, **90,** 549-551.
[32]H. Kienitz, Z. *Elektrochem.*, 1955, **59,** 168-172.
[33]A. Kofler, *Ibid.*, 1955, **59,** 939-941.
[34]Yu. A. Krishtal, *Doklady. Akad. Nauk S.S.S.R.*, 1954, **98,** 395-397.
[35]J. A. Labash and G. R. Lusby, *Can. J. Chem.*, 1955, **33,** 774-786.
[36]N. I. Litunovskii and O. M. Todes, *Zhur. Tekh. Fiz.*, 1953, **23,** 1125-1134.
[37]H. Lüdecke, *Landwirtsch. Forsch.*, 1954, **7,** 24-30.
[38]B. Makower and N. B. Dye, *J. Agr. Food Chem.*, 1956, **4,** 72-77.
[39]G. Matz, *Chem.-Ing.-Tech.*, 1955, **27,** 18-22.
[40]L. Ya. Mazelev, *Izvest. Akad. Nauk Beloruss. S.S.R.*, 1953, 105-113.
[41]M. Milone and G. Cetini, *Gazz. Chim. ital.*, 1954, **84,** 133-142.
[42]A. Mircev, *Listy Cukrovar*, 1954, **70,** 221-222.
[43]A. Mircev and K. Sandera, *Ibid.*, 1955, **71,** 37-40.
[44]S. Misumi, Y. Ishikawa and L. Tanaka (to Ube Soda Industries Co.), Jap. Pat. 6,870, Oct. 23, 1954.
[45]T. Moriyama and T. Yawataya, repts. research lab. Asahi Glass Co., Yokohama, 1954, **4,** 42-49.
[46]B. Morris and R. F. Strickland-Constable, *Trans. Faraday Soc.*, 1954, **50,** 1378-1393.
[47]K. Neumann and G. Micus, Z. *physik Chem. (N.F.)*, 1954, **2,** 25-39.
[48]L. R. Nylander (to Stockholms Superfosfat Fabriko A.B.), Swed. Pat. 146,307, July 27, 1954.
[49]K. Oda *et al.* (to Noguchi Research Inst. Inc.), Jap. Pat. 7,470, Nov. 15, 1954.
[50]Officine Meccaniche e Fonderie A. Bosco Società per Azioni, Ital. Pat. 485,779, Oct. 17, 1953.
[51]T. Osugi *et al.* (to Kurashiki Rayon Co.), Jap. Pat. 6,422, Oct. 9, 1954.
[52]J. A. Palermo, C. S. Grove and H. M. Schoen, *Ind. Eng. Chem.*, 1955, **47,** 520-523.
[53]R. P. Rastogi and A. C. Chatterji, *J. Phys. Chem.*, 1955, **59,** 1-3.
[54]D. Roberts, *Chemistry in Can.*, 1955, **7,** 60 and 62.
[55]E. E. Rush (to Phillips Petroleum Co.), U.S. Pat. 2,696,307, Dec. 7, 1954.
[56]I. E. Sadovyi, *J. Appl. Chem. (U.S.S.R.)*, 1953, **26,** 875-883.
[57]W. C. Saeman, *A. I. Che. E. Journal*, 1956, **2,** 107-112.
[58]G. Schuur, Rubber-Stichting (Delft) Commun. No. 276, 1955, p. 82.
[59]H. Seifert, *Chem.-Ing.-Tech.*, 1955, **27,** 135-142.
[60]K. Seshadri and J. Gupta, *J. Sci. Ind. Res. (India)*, 1954, **13B,** 788-791.
[61]M. P. Shulgina, O. S. Kharchuk and O. K. Yanateva, *Izvest, Sektora Fiz.-Khim. Anal. Inst. Obshchei i Neorg. Khim., Akad. Nauk S.S.S.R.*, 1955, **26,** 198-210.
[62]N. V. Stamicarbon, Dutch Pat. 77,075, Jan. 15, 1955.
[63]K. Suzuki, *J. Chem. Soc. Japan, Ind. Chem. Sect.*, 1954, **57,** 763-765.
[64]Sh. T. Talipov and T. I. Fedorova, Trudy Sredneaziat. Univ. No. 40, Khim. Nauki No. 5, 1953, pp. 47-55.
[65]H. Tonn, Z. *Zuckerind*, 1955, **5,** 173-176.
[66]M. L. Varlamov and Ya. I. Starosel'skii, *Khim Prom.*, 1954, 185-186.
[67]P. Vicaire, *Bull. soc. franc. mineral et cryst.*, 1954, **77,** 1410-1417.
[68]G. F. Wright, *Can. J. Technol.*, 1954, **32,** 250-252.
[69]F. Yoshimura and M. Maruoka, Japan Pat. 6,167, Sept. 27, 1954.

Piping. How processing and power piping costs can be reduced substantially is discussed in a 12-page brochure published by the M. W. Kellogg Co. Detailed is the Kellogg 'general analytical method of piping flexibility analysis,' representing a comprehensive approach devised for evaluating stresses, reactions and deflections in complex piping networks. Also described are Kellogg's piping model test and its electronic computing facilities, used to solve those systems which cannot be solved 'manually' with economy. An interesting feature is the solution of a typical piping stress problem—a high-temperature reheat system for a utility central station—by both the general analytical method and the model test.

Cutting Costs Through Fuel Efficiency

Case Histories from the Chemical and Allied Industries

(Specially Contributed)

A viscose film works effected a saving of 1,000 *tons of coal a year by cutting down heat losses. A chemical factory was able to do without one of its three boiler houses. Another large fuel user converted a boiler plant to oil firing and achieved a total saving amounting to* £4,625 *at present-day costs. These are some examples of fuel efficiency cited in this article, which includes some case histories from the chemical and allied industries and also includes some comments on the work of the National Industrial Fuel Efficiency Service and on the fuel situation generally.*

THE chronic fuel shortage which has continued since the war involves the whole of British industry in two problems: the first is to get enough fuel of any kind to meet ordinary needs, and the second is to meet the rising cost of the fuel available. The price of coal has recently gone up again and there are very good reasons for this, one of which is the cost of foreign coal needed to make up for the shortage of home production. The irony of the matter is that this should happen in a country which, it has been said, is built on coal and which has been one of the greatest exporters of coal to the rest of the world.

The purpose of this article is not, however, to discuss the reasons for the coal shortage, but to offer suggestions to help overcome the difficulties which that shortage brings—for there *are* ways in which fuel can be made to do more work. If this can be done, it means that less fuel is required for the same output from factories and that the cost of fuel per unit of production is lower.

It is now two years since the National Industrial Fuel Efficiency Service, which is known as N.I.F.E.S., was set up to help industrialists to use their fuel more efficiently. It should be said at once that N.I.F.E.S. is a non-profit-making company, without compulsory powers, which can offer advice only when it is asked to do so. If the advice it gives is not followed, the matter rests there. During the two years since its establishment, however, the advice of the Service has been sought by more than 9,000 firms and non-industrial establishments using more than 100 tons of coal a year. It has been calculated that there are altogether something like 30,000 such fuel users, so it is evident that the work done by the Service is getting known.

Even though its reputation has grown quickly by ordinary standards, the Service would like its message of hope to spread at a much greater speed. The situation is this: it is estimated that in almost every works to which N.I.F.E.S. engineers go there can be savings in fuel consumption of the order of 10% or more. The coal allocated for industrial use each year is approximately 50 million tons. If 10% or more of that coal could be saved, it is obvious that the saving would go a long way to meet the need for importing coal. When it is remembered that industrial consumption is rising, as it must if industry is to become more efficient and highly mechanised, the savings assume an even greater importance.

Here is a faulty steam trap (and how!) being investigated by a N.I.F.E.S. engineer.

SOME FUEL ECONOMY CASES FROM THE CHEMICAL INDUSTRY

Striking economies can be achieved in the operation of coal-fired boilers. The following case histories show the results of investigations by N.I.F.E.S. carried out at the request of firms in the chemical industry.

Steam production efficiency increased

At the Stallingborough, Lincolnshire, works of Laporte Titanium Ltd., steam is produced in a battery of coal-fired, shell-type boilers and, at a higher pressure, in acid plant waste-heat boilers.

In 1954 the plant, which had been constructed on a virgin site, was working on a continuous production basis but the management was not satisfied that steam production was completely efficient. N.I.F.E.S. was called in to make an inspection of plant, records and methods of operation, and they confirmed subsequently that efficiency was, in fact, lower than it should have been.

A number of contributory causes were pin-pointed. Teething troubles in the coal handling plant, which had distracted the operator from plant control, were overcome and small modifications were made to plant and instrumentation. Incentives were offered to the boiler house staff to encourage them to obtain training and to achieve improved results. The boiler house men, for their part, showed keen interest in plant operation and two of them entered for a Boiler Operator's Certificate course at the nearest centre. Full advantage was taken of any advice or instruction given by the N.I.F.E.S. engineer who, at the request of the firm, was now visiting under a Regular Service Agreement.

Comprehensive records are kept and

the figures per pound of steam exhausted from the boiler house per pound of coal used show the effect of the increased efficiency. The figure in May 1955, when the Regular Service Agreement commenced, was 5.76. This showed an improvement on the original figures, but by February 1956 the figure had risen to 6.7. On present coal consumption this represents an annual saving of approximately 1,000 tons.

The work is continuing and a notable feature has been the willing and effective co-operation between the management, the operating staff and the N.I.F.E.S. engineer in their efforts to get the best results.

A boiler house dispensed with

Another example of progressive economies is furnished by J. W. Leitch & Co. Ltd., of Huddersfield. When this works was taken over by new management, Hickson & Welch Ltd., towards the end of 1954, steam was raised in six Lancashire boilers in three separate boiler houses. The management entered into a Regular Service Agreement with N.I.F.E.S. and the most obvious sources of fuel wastage were tackled systematically. First, several steam engines and pumps exhausting to atmosphere were replaced by electrically driven units. Then, following tests in the various boiler houses, it was found possible to run the whole works on two boilers, one boiler house being completely closed. Fuel consumption was thereby reduced from 100 tons/week to 50 to 55 tons/week, despite longer working hours and increased production. Steam linkage between the remaining boiler houses is under construction and it is expected that a further saving of at least 10 tons/week will be achieved, while maintaining the increased rate of production. In addition to the actual fuel savings, there has been a marked reduction of smoke emission from these premises.

Although savings of this magnitude cannot generally be expected it is worth emphasising that the purpose of the plan for regular visits is to maintain a high standard of operating efficiency to ensure that, once improvements have been obtained, they are held day in and day out.

Coal consumption reduction

Another example of a firm giving constant attention to fuel efficiency is the B.B. Chemical Co. Ltd., Leicester, who have effected considerable improvement in the generation and usage of steam at their Ulverscroft Road works.

At a time when increased production requirements have caused the steam demand to rise by more than 25%, their coal consumption has been reduced by approximately 8%.

Plant improvements have included the installation of an economiser, sprinkler stokers, boiler instruments and automatic control of the feed pumps. The steam pipes have been straightened up and runs of pipe have been shortened. Sight glasses fitted to steam traps have made it easier to find steam blowing to waste and renewable seat valves have helped by cutting out the odd leaky valve.

Considerable attention has been paid to lagging, condensate return, air venting of boiling pans, roof insulation of new buildings and the reduction of pressures where possible for space heating.

In addition, the boiler operator has attended a course of training at the Leicester College of Technology.

Steam demands in this progressive company are continuing to increase and, aware that the boiler capacity has nearly been reached, the management asked N.I.F.E.S. to make monthly visits under a Regular Service Agreement to investigate the possibility of increasing the efficiency of the plant still further and to ensure that the highest standards of maintenance and operation are constantly applied.

Fuel economy at a viscose film works

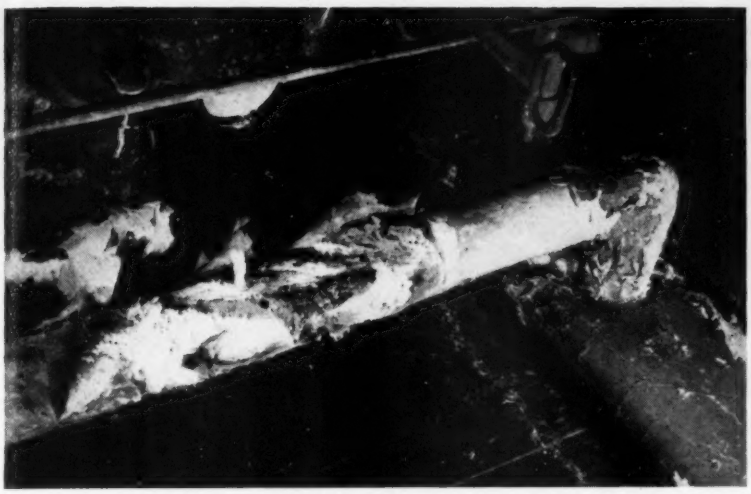
The works of British Rayophane at Wigton, Cumberland, is devoted to the manufacture of viscose film. An investigation of the plant was carried out by engineers of the Ministry of Fuel and Power in December 1950, when fuel consumption was 12,974 tons p.a. of coal. The Ministry engineers advised that, by various increases in efficiency, savings of up to 64 tons/week of coal could be effected. Some of these recommendations were carried out, with the result that by the end of 1951 coal consumption had dropped to 11,540 tons p.a. the saving being worth more than £4,000 at prices then ruling.

The N.I.F.E.S. were subsequently called in to determine the heat losses and requirements of the factory. At one stage the viscose film passes several times through baths heated with steam and this causes a heat loss three times as great as that from the surface of the bath itself. Measurement of steam flow showed that an additional 100 tons p.a. of coal was required for every 1°C. excess above the minimum. There is every indication that 1,000 tons p.a. of coal will be saved without incurring any expenditure whatever on plant modification.

FUEL AND THE FUTURE

Many people are looking to nuclear power to ease the fuel situation. They feel that an additional source of power must make a big contribution to the needs of industry and the home. Unfortunately, that contribution is still far ahead in the future. It is true that, already, one of the nuclear piles at Calder Hall is 'critical' and that

Unenclosed settling tanks leading to great waste of heat as effluent from the dye vats cools in the open air.



Left: An example of badly maintained lagging and, right, steam distribution pipes being lagged.

the whole station will soon be feeding current into the grid. It is also true that plans have been made, and some constructional work is now in progress, for a string of other nuclear power stations. But the truth is that this additional source of energy will not even make up for expected new demands for years to come. It is thought that by about 1980, on the basis of present plans, all new electricity power stations will be operated by nuclear energy. That is more than 20 years away and, in the meantime, the demand for electrical energy will probably double itself. The population now in infancy will reap the benefits of the work which we are doing in this field at the present time, but our need is for more fuel now.

Oil as a fuel

Whichever way we turn for energy we find barriers—of scarcity, of cost and of shortages of foreign currency. One ray of hope shed on the gloomy picture is that produced by the import of oil fuel. A number of new, conventional power stations are being adapted to oil firing because oil is available. The strategic difficulties in which we might find ourselves if we were cut off from the sources of oil supply are being overlooked because the present need is great enough to over-ride the potential problem.

While oil has a calorific value of 1.6 times that of coal, it must not be assumed that conversion to its use in all cases will solve the problems. Conversion should be made only after assessing the individual merits of each case. Factors such as the cost of solid fuel in the locality concerned and whether delivery charges on the oil would raise its cost beyond the point where it would be an economic proposition, however desirable its use might be, must be taken into account. If the circumstances are suitable, oil firing can produce excellent results, which are illustrated by the following case history. While this does not relate to the chemical industry, the case is of particular interest because it shows what can be done to overcome difficulties and use boiler plant efficiently when a determined effort is made.

A successful case of oil conversion

A little over a year ago, the South East Metropolitan Regional Hospital Board agreed that the Bermondsey and Southwark Group Hospital Management Committee should convert the boiler plant at St. Olave's Hospital to oil firing. The plant was then hand fired and the bad conditions in the boiler house made it difficult for the hospital to retain staff. When the conversion was completed, the number of men in the boiler house was reduced by one stoker and two trimmers and the problem of staff retention has been considerably reduced. The dust and dirt nuisance, which was particularly bad, has now been eliminated.

The figures based on the twelve months' working are very interesting. The assumption is made that coal consumption would have followed the pattern of the previous twelve months; that is to say, 2,332 tons, and the figures are:

	£
Cost of coal which would have been used	15,402
Cost of oil actually consumed (382,185 gal.)	13,370
Saving on fuel, therefore ...	2,032
Saving on labour (one stoker and two trimmers)	1,475
Total saving, therefore	3,507

On the basis of present-day costs the economy is even greater:

	£
Coal, at £6 16s. 6d. per ton* ...	15,915
Oil used (382,185 gal.)	12,850
Saving on fuel, therefore ...	3,065
Saving on labour	1,560
Total saving, therefore	4,625

*This does not take into account the most recent rise in coal prices.

The actual cost of converting the plant to oil firing was £3,676, which was rather lower than might have been expected because the hospital obtained some second-hand equipment and adapted some spare plant from another hospital. The present-day cost of the conversion would also be higher. The fact is, however, that the cost of conversion has been almost entirely offset by the saving in fuel and labour costs during the first year of operation.

Loans for fuel savers

It will be realised that, in every instance of fuel economy cited in this article, the suggestions and recommendations put forward by N.I.F.E.S. engineers amounted to commonsense informed by expert experience and knowledge. In some cases new plant and instrumentation were called for and it should be remembered that, wherever expenditure of this kind is needed, there is the Government Loan Scheme to help firms who may be short of the capital required. The scheme offers most, if not all, of the money needed for new equipment to be installed to save fuel. The loans are free of interest for two years after

(*Concluded on page* 229)

Ore-Dressing Research in India

(Specially Contributed)

This is the third annual critical review of ore-dressing research conducted in India, first and second reviews having appeared in CHEMICAL & PROCESS ENGINEERING *for April* 1954 *and June* 1955 *respectively. Ore-dressing research in India during* 1955 *was highlighted by a study of the role of depressants in sulphide and silicate flotation, beneficiation of graphite, phosphate rock and chromite by tabling and flotation, upgrading of vermiculite by heavy media separation and tabling, and the differential flotation of beach minerals.*

Role of depressants

IN view of the importance of pyrites to Indian economy, further studies on the beneficiation of pyrites have been undertaken.

A sample of pyrites from Amjor, Bihar, associated with shale, melanterite ($FeSO_4 7H_2O$) and limonite received for beneficiation was of fairly good grade and assayed 41.77% sulphur as FeS_2 and 1.74% as $FeSO_4$.[1] Tabling after grinding to –35 mesh yielded a concentrate of 46.8% sulphur grade with a rather low recovery of 61.1% only, while tabling followed by flotation of the tails produced a combined concentrate assaying 46.2% sulphur with a recovery of 94.8%. Straight flotation at 75% –150 mesh grind at *p*H 4.4 with 0.3 lb./ton of ethyl xanthate and 0.28 lb./ton of pine oil gave a concentrate with a sulphur assay of 46.9% at 93.6% recovery. Copper sulphate as an activator or sulphiding with sodium sulphide did not help in reducing the tail assay.

The primary concentrate carried 7.4% silica due to the flotation of shale; however, a cleaner concentrate with 50% sulphur at 90% recovery could be obtained.

In another detailed study, the role of alizarin red S as a depressant for silica and gangue minerals in the flotation of pyrites from Ingaldhal, Chitaldrug District, Mysore, has been elucidated.[2] The sample assayed 27.8% sulphur as pyrites and marcasite with 16.1% silica as chlorite and quartz, together with small amounts of magnetite and hematite. Straight flotation at *p*H 4.5 with 0.25 lb./ton of potassium amyl xanthate, 0.5 lb./ton of copper sulphate and 0.35 lb./ton of pine oil yielded a concentrate with 46.05% sulphur at 90.3% recovery. The addition of 0.25 lb./ton of alizarin red improved the grade to 47.8% and recovery to 90.7%.

In view of the rather higher grade of the ore, experiments have been conducted with artificial admixtures of silica so as to have low-head assays of 14 and 5% sulphur. It has been found that the use of the depressant dye for siliceous gangue improves the grade by about 1% and the recovery by nearly 2% and has been admitted that the improvement is not spectacular.

However, the nature of pyrites interlocking in the tails after a regrind (98.9% – 200 mesh) has been unravelled through mineragraphic studies. It has been found that the pyrite is locked as fine blebs in quartz and magnetite gangue and that liberation would be uneconomic.

The influence of alizarin red S has been investigated in the beneficiation of beryl ore.[3] Beryl ore dust from Rajasthan assaying 8% BeO contained as gangue quartz, felspar, calcite, mica and tourmaline. In floating the gangue, the ore was first acid-treated with hydrochloric acid; the best result that could be obtained was a sink which assayed 11.09% BeO with a poor recovery of 33.6%. The reagent consumption per ton was 0.83 oleic acid, 0.5 of terpineol, 0.8 of barium chloride and 2.8 of alizarin red S. A modification of the conditions improved the recovery to nearly 60%, but with a fall in the grade to 10.6%.

In the straight flotation of beryl, after a preliminary hydrofluoric acid treatment at *p*H 6.3, the best result obtained was a concentrate of 11% grade and 84% recovery. The slime losses were considerable.

In another study on the fatty acid flotation of alumina,[4] aniline and a mixture of thiocarbanilide and sodium hexametaphosphate have been tried at 0.45 lb./ton as depressants for iron oxide at *p*H 6. A concentrate of 70.8% grade and a recovery of 82% have been obtained. Magnetic separation after a reduction roast at about 450°C. gave good results.

In understanding flotation results by the critical pick-up method of Last and Cook,[5] it has been found[6] that, in the presence of a depressant like sodium silicate, a larger amount of collector is required and that oleic acid is easily adsorbed on alumina at *p*H 7, conforming to the free-acid adsorption theory of Cook and Nixon.[7]

Plumbago

The upgrading of three samples of low-grade graphite from Betulganj (Madhya Pradesh) has been undertaken on the recommendation of the Indian Tariff Board.[8] The first sample had a carbon content of 7.78% with 86.16% ash and 6.06% volatiles and moisture. The gangue was quartz, muscovite, kaolinite and chlorite while the graphite was in intimate association with micaceous minerals.

Flotation using soda ash as gangue depressant at 4 lb./ton and pine oil at 0.08 lb./ton followed by a regrind to 85% –200 and a cleaning gave a concentrate with 69.5% carbon and 26.8% ash at 21.3% recovery. Modifying agents such as sodium silicate, calgon, sodium hydroxide, lactic acid and sulphuric acid did not improve the results. An infra sizar test with the cleaner concentrate showed that even in the –10μ size graphite was interlocked with mica. It was concluded that graphite of high grade suitable for plumbago pencils could not be made but the product could be used for foundry purposes.

The two other samples gave poorer products which would not be suitable even for foundry purposes.

Pilot-plant trials have been undertaken on the beneficiation of phosphate rock from Singhbhum (Bihar) at the instance of the Tata Iron & Steel Co., Jamshedpur.[9] The head assay was 27.2% P_2O_5 while the contaminant minerals were magnetite, limonite, quartz, asbestos, chlorite, biotite and a trace of chalcopyrite. Magnetic separation of a –20-mesh product gave a non-magnetic fraction containing 34.77% P_2O_5 with a recovery of 90.3%. Straight flotation using 2 lb./ton of sodium silicate and 2.5 lb./ton of a

Table I. Results of Experiments on Beneficiation of Vermiculite[14]

Sample	Tabling		H-M separation	
	Bulk density, lb./cu.ft.	Exfoliation index	Bulk density, lb./cu.ft.	Exfoliation index
Bageshpura	9.0	5.6	9.8	5.5
Malavanghatta 1 ..	14.9	4.3	14.5	4.5
Malavanghatta 2 ..	13.7	5.0	13.9	4.9

mixture of sodium oleate and oleic acid gave a concentrate with 37.83% P_2O_5 and a recovery of 72.1%.

Increase of flotation time improved the recovery to 86.3% though with a slight fall in the grade. Tabling followed by flotation of tails yielded a product with 38.1% P_2O_5 at 85.2% recovery. The rather low recoveries in the tests have been attributed to the inefficient collector action of oleic acid in dilute form and it is hoped that the better dispersion of the collector as an emulsion in caustic soda would improve plant performance.

Samples of chromite from Ostipal (Orissa) assaying 41.4% Cr_2O_3 and 34.2% Fe with ferruginous ochre as main gangue have been upgraded, after a reduction roast at 500 to 560°C. with coke-oven gas, by magnetic separation. The concentrate carrying 60.5% Cr_2O_3 and 15.07% FeO forms the ideal raw material for the production of low-carbon ferrochrome as the Cr: Fe ratio exceeds 3: 1 specified for metallurgical grade of ore.[10]

The same treatment of reduction roast and magnetic separation has produced a concentrate having 43.06% Mn from a low-grade manganese ore from Miragpur mines (Madhya Pradesh).[11]

Vermiculite

Vermiculite (an alteration production of phlogopite mica) from Mysore, having a bulk density of 12.1 lb./cu.ft., has been beneficiated by attrition grinding in a ball mill and tabling the −20-mesh product.[12] The bulk density varied from 7.6 lb./cu.ft. upwards and a recovery of 98% was recorded. Exfoliation studies on the mineral have shown the mineral to possess an average exfoliation index of 6.3 and suitable for use as fine aggregates in making concretes and plasters.[13]

In another study, tabling and heavy-media separation have been tried on three Mysore samples.[14] The samples consisted in the main of fines and the gangue, present in a highly altered condition, consisted of quartz, felspar, hornblende, serpentine, magnetite, laterite, apatite, granitic gneiss and clay. In the experiments, the +10-mesh fraction gave the best products. The results are recorded in Table 1.

Flotation of vermiculite in the different size ranges of −60/+100 and −100/+120 has been attempted under different conditions of hydrogen ion concentration, collector variation and concentration and activation. In a comparison of the performances of oleic and linoleic acids as collectors, it has been found that linoleic acid is better, providing a wider range for flotation.

Beach sands

The beach sands occurring in Travancore have been shown to be amenable to differential soap flotation without any crushing or grinding, as the sieve analyses show: 20% −44/+60; 58% −60/+100; and 16.9% −100/+160.[15] In vacuuamatic cylinder tests with oleic acid as collector, barium chloride as activator, alizarin red S as depressant and terpineol as for other, the *p*H ranges of flotabilities are: zircon 0.65 to 11.8; rutile 1.1 to 11.5; monazite 2.3 to 11.3; and ilmenite 2.9 to 10.7. Ba^{++} acts as activator for zircon and ilmenite only.

The results have been explained on the basis of the electrical double-layer theory. The depressing action of the dye has been attributed to the formation of a hydrophilic dye film on the surface rather than deactivation of the mineral.

The effect of Ba^{++} as a ' depression sensitiser ' has been studied and found to be fairly moderate in the lower critical *p*H range for all the minerals and to increase with increase in dye concentration. Differential flotation at different *p*H and reagent concentrations has been tried and a continuous flow sheet suggested.

A plant, believed to be the pioneer in India, has been established at the Associated Cement Works, Khalari, to treat limestone containing pyrogenetic materials of high silication such as pyroxenes, amphiboles, hornblende and biotite.[16] Two rows of 12 Fagergren flotation cells each, acting as roughers and finishers respectively, handle 40 tons/hr. of feed and deliver a concentrate carrying 48.7% CaO and 8.4% SiO_2 among others.

Another ore-dressing equipment of note that has been installed is a Dorr-Oliver thickener at Sindri where the Associated Cement Co. have put a special plant for making cement utilising the by-product calcium carbonate slurry thrown out of the Sindri fertiliser factory.

Lastly, mention should perhaps be made of classified work relating to the beneficiation of uranium and other minerals used in atomic energy work in India.

REFERENCES

[1]Banerjee and Narayanan, *J. sci. industr. Res.*, 1955, **14B**, 117.
[2]Unpublished data.
[3]Srinivasan and Aswath, *J. Ind. Inst. Sci.* (in print).
[4]Deshpande and Bhat, *Ibid.*, 1955, **37A**, 53.
[5]Last and Cook, *J. Phys. Chem.*, 1952, **56**, 637.
[6]Deshpande and Bhat, *J. Ind. Inst. Sci.*, 1955, **37A**, 141.
[7]Cook and Nixon, *J. Phys. Chem.*, 1950, **54**, 445.
[8]Mathur and Narayanan, *J. sci. industr. Res.*, 1955, **14B**, 236.
[9]Banerjee and Narayanan, *Ibid.*, 1955, **14B**, 242.
[10]Anon, *C.S.I.R. News*, 1955, **5** (15), 3.
[11]*Idem, Ibid.*, 1955, **5** (17), 3.
[12]*Idem, Ibid.*, 1955, **5** (8), 3.
[13]Patwardhan and Rao, *J. sci. industr. Res.*, 1955, **14B**, 313.
[14]Srinivasan and Ramamurthy, *Curr. Sci.*, 1955, **24**, 192.
[15]Nayak, Thesis A.I.I. Sc., 1955.
[16]Associated Cement Co., *Ind. Minerals*, 1955, **9**, 118.

Cutting Costs Through Fuel Efficiency

(*Concluded from page* 227)

the installation and are then charged only at current commercial rates. The period of the loans can extend to 20 years, or the taxation life of the new plant installed.

In practically every case the cost of the loan and its repayment can be met out of the savings brought about by the use of the new equipment.

In addition, the Chancellor of the Exchequer, in his Budget proposals this year, announced that he proposed adding fuel-saving equipment to plant which would qualify for investment allowances. This concession underlines the importance attached to fuel efficiency because the only other exceptions to the general rule of ' no investment allowances ' are shipping and scientific research.

It has been possible to quote names of firms in the case histories dealt with in this article only by permission of the companies concerned. Reports of visits made by N.I.F.E.S. engineers are confidential and nothing concerning the visits is divulged without the consent of the firms. It is obviously of value to the N.I.F.E.S. to be able to give names, figures and places, but it is for those concerned to agree, or not, as they wish.

Safe Use of Trichlorethylene

Some Codes of Practice for Industrial Use

IN the past 15 years, some 250 cases of gassing by trichlorethylene have been reported by the Chief Inspector of Factories. By far the majority of accidents have arisen in the industrial use of this non-flammable solvent, the valuable extraction properties of which offer wide application in manufacturing processes. The figure emphasises an important feature of trichlorethylene—its marked inhalational hazard.

A definition of the specific precautions demanded in the use of trichlorethylene should make working completely safe. The hazards are readily located. Briefly they comprise:

(1) **Inhalation of vapour concentrations** in excess of safe levels, the effects varying from dizziness to death, depending on the duration of exposure and the amount of concentration. The maximal allowable average concentration in work places is agreed as 200 p.p.m., equivalent to about 1 mg./l. or 1 g./cu.m. The rather sweet odour is normally detectable at concentrations below 200 p.p.m.

As with other sparingly soluble liquid solvents, the relative insolubility of trichlorethylene in water, and therefore in the blood plasma, implies that quite short exposures to high concentrations may cause rapid physiological effects, even though the total amount of vapour inhaled is small. The acute narcotic effects of overexposure to vapour usually pass off fairly quickly after removal from the concentration. Here again the speedy recovery is due to the relative insolubility of trichlorethylene in blood plasma and the consequent time lag required for its transference to the tissues of the body.

(2) **Dermatitis**, from the action of liquid trichlorethylene or very high concentrations of its vapour on the skin. This is not a major hazard and, if the period of contact is short or only sporadically repeated, there is likely to be no response. But, if the contact is prolonged, as with the immersion of the hands in the solvent during degreasing operations, or with constant local saturation of clothing, skin blistering may occur.

(3) **Inhalation of irritant decomposition products** of the heated solvent. Hydrochloric acid is one such decomposition product.

Even though trichlorethylene is essentially non-flammable and non-explosive, it is unwise to have an open flame in the vicinity of the solvent when it is used as a degreaser. Explosions which have occurred under such circumstances indicate that trichlorethylene decomposes under the effect of heat to hydrochloric acid and dichloroacetylene, the latter being inflammable. Some authorities hold that trichlorethylene and other chlorinated hydrocarbons are partially converted to phosgene by the heat from hot surfaces or local flame and, although other scientific sources dispute the phosgene theory, it is an empiric fact that an irritant gaseous decomposition product is released.

(4) **Secondary poisoning** arising from other toxic substances conveyed in solutions of trichlorethylene, either radioactive or non-radioactive. The safety code that effectively controls these hazards is clear enough. The design and location of plant is a key factor in the safe-working technique. Plant should not be sited near windows or open doors, to obviate the risk of high local concentrations set up by draughts.

Whenever practicable and certainly with large vats, local extraction ventilation of the lateral-slot type is advisable. Tanks should be, if possible, not more than 10 sq. ft. in cross-section, and the general ventilation in the workshops in which they are located should give a high number of air changes per hour. Exhaust air containing solvent vapour should be expelled in a technique that prevents it from blowing back into work areas.

Tank cooling and condenser capacity need care, from the safety angle, and the coils should be installed as near as practicable to the solvent surfaces, while thermostatic control of the cooling-coil temperatures is advisable, with provision for an alarm system in the event of control failure. Techniques for emptying the vats should ensure that drainage is complete without any residual pocketing. No platforms, handrails and so on should be located over tanks where it is possible that vapour may be emitted into the air above the tank. Well-fitting covers should be installed on all plant such as degreasing equipment, when it is not in operation.

Process precautions

The work process itself demands strict blanketing with safety measures, particularly in degreasing. Parts being degreased should be thoroughly drained (suspension in frames will facilitate this and so will a slow withdrawal at a rate less than 20 linear ft./min.) and on no account should degreased components be allowed to dry in the general air of workplaces. Sludge from the vessels must be disposed of in such a way that it does not remain exposed to the atmosphere of the workshop.

All the vicinity where plant emitting solvent vapour is located must be kept completely free of open flames, and trichlorethylene should not be brought into contact with hot metal.

The process should not demand from any operator prolonged or recurrent immersion of the hands in the solvent and all operators should be trained to prevent the splashing of their clothing, while protective wear will, of course, do much to provide resistance to any potential action of the solvent. Aprons, gloves, armlets and so on should be of non-absorptive material.

Maintenance routine

Maintenance and inspection routines demand certain safety provisions. Thorough ventilation of the vessels must precede any cleaning operations and a system of certification for permission for entry is a sound item in the accident prevention code. Breathing apparatus should always be worn and all maintenance work in this connection should be a two-operator job, one standing by for emergency.

Where there is a possibility that there has been liquid spillage of trichlorethylene, the immediate area should be instantly vacated and adequately protected personnel set to investigating the occurrence. The quick method of detection is, of course, the use of the halide detector lamp as recommended by the Department of Scientific and Industrial Research. In this, the chloride liberated on ignition of the vapour reacts with a copper screw in the flame and imparts a greenish colour to the flame. More exact determination is by standard methods.

So much for the broad pattern of the safe working code that should apply with trichlorethylene. As a solvent for dyes, pitch, tar, bitumen, sulphur, waxes, vinyl resins and so on, it is in very wide use, and it can be absolutely safe to work if the requisite code of practice is scrupulously defined and observed.

H. ALLEN

Sweden's industry, helped by the application of chemical and chemical engineering knowledge, has advanced to a level where it compares favourably with other European countries which had a considerable start on it in the way of technology and resources. Here we publish a survey which will appear in two parts, the first dealing with Sweden's natural resources, fuel and power assets, and metallurgical industries. Part 2, to appear in a later issue, will cover the chemical industry. Mr. Tow led a group of chemical engineers on a tour of Sweden last year, and this survey is based partly on that visit and partly on published information.

A Survey of SWEDISH INDUSTRY

(Part 1)

By D. J. Tow and W. C. Paterson

SWEDEN—FACTS AND FIGURES

Sweden covers an area almost double that of England and Scotland together. Its length from north to south—some 980 miles—is greater than the distance from Stockholm to London; its greatest width is 309 miles. The population—7 million—is smaller than London's.

There are in Sweden only a few and fairly small open plains and they are all situated in the southernmost third of the country. Over half of the country is covered by forests and a further 9% by lakes and rivers. Despite the fact that most of Sweden lies in a latitude north of Labrador, it has a temperate climate.

SWEDEN'S natural resources consist, in the main, of forests, ores (chiefly iron ore) and water power. The abundance of these resources has influenced not only the economic development but also cultural progress throughout the country. This also applies very largely to Sweden's export of raw materials and the establishment of industries for the utilisation of such raw materials.

Industrialisation came late to Sweden, and not until the 1930s did manufacturing replace agriculture as the leading industry. Today 38% of all Swedes are supported by manufacturing, 28% by agriculture and 20% by trade and transportation.

The manufacture of semi-finished and finished products in the iron and steel trade is carried on in central Sweden—the old centre of this trade—while the saw mills and pulp mills are situated in north Sweden, and in the southern territory paper mills and other branches of industry are established.

In the 17th and 18th centuries timber from the huge forests of the country was used primarily for the mining of ore and the production of copper and iron. Wood converted into charcoal is still universally employed for the production of the finer grades of pig iron and steel.

Metals

The ancient iron mines in central Sweden still supply the bulk of the ore employed by the Swedish steel works. The Lapland iron mines, in the extreme north, yield a high-percentage iron ore usually with a high phosphorus content, which since the beginning of this century has been shipped in large quantities to the continent of Europe and to Great Britain and the United States. Highly arsenious ore found in the north is processed to produce large quantities of arsenic for insecticides and the impregnation of timber.

Iron alloy metals are scarce, and tungsten accounts for the bulk of their output. Vanadium needs can be met domestically, but the small deposits of molybdenum, manganese and nickel ores have been mostly exploited. Chromium has never been found in any worthwhile concentrations.

The sulphide ores of the Skellefte region yield zinc, lead, copper, gold, silver, bismuth, cobalt and huge quantities of arsenic. Lead, copper and zinc make up 40 to 50% of current output value; gold and silver have fallen off to a mere 10%.

The Falu copper mine, once one of Europe's primary sources of copper,

continues to yield zinc and lead ores. Sweden's largest zinc deposits are at Ammeberg; the ore is exported.

Timber

The standing timber is estimated at more than 10 billion trees, representing a lumber supply of 50 billion cu. ft. Pine and fir are the most important species industrially. A lumber tree needs 90 years in the south and 180 years in the north to mature. A firmer and more durable wood is partial compensation for the slow growth.

Cutting and conservation are regulated by law. Because of much cutting before and during the war, lumbering from 1946 to 1950 was limited to 80% of the 1.06 billion cu. ft. conservation limit.

Cheap transport of logs is assured by the many rivers which flow through the forests to coastal sawmills and pulp plants. These rivers carry an annual log volume of 400 to 500 million cu. ft.

Fuel resources

A balance sheet of Sweden's fuel economy shows ample resources of water power, wood and peat, but no oil and only small deposits of second-rate coal. In 1949, 30% of the energy was provided by water power, 23% by domestic fuels and 47% by imported fuels.

There are some coal deposits around Höganäs in the southernmost part of Sweden. For some part of the war years, coal was mined at an annual rate of 600,000 tons, corresponding to more than 10% of peace-time consumption. Today, production is only one-half of the war-time peak. Unfortunately, domestic coal has a considerably lower fuel value than ordinary imported coal, because of its high ash and water content. It is also unsuitable for the production of coke. Under normal conditions coal mining would not be profitable if fireclay were not obtained at the same time.

Vast deposits of shale are found, but the oil content is very low. The Government built a large distilling plant at Kvarntorp during the war for the extraction of liquid fuel.

The vast peat resources of this country are utilised only on a small scale, but a Government-owned company is conducting extensive research on methods of converting the peat into fuel. The greatest problem is to dry the peat, which contains only 10% solid matter.

Almost 70% of forest cuttings during the last war were for fuel. About 20% went to the production of charcoal, which was used not only by the steel industry but also, like firewood, by automobiles equipped with apparatus for the generation of producer gas. A flourishing charcoal industry sprang up, and large quantities of essential by-products were obtained. Today, only 30% of felled timber is set aside for fuel and the rest is used by the forest industries. Charcoal manufacturing is once more based mainly on the ancient method of stacking and covering the wood for charring right in the forest. No by-products are obtained, therefore; instead, the quantities transported from the forests are reduced to a third.

Chiefly as a result of the large-scale use of black oils in industry and in domestic heating, Sweden's inland consumption of petroleum products has increased almost six times since pre-war, reaching 5.8 million metric tons in 1954, and continues to increase at a rapid rate. Black oils accounted for over 75% of 1954's consumption, compared with less than 30% in 1938. Coal imports have declined and a further switch from coal to oil is foreseen. Sweden has by far the largest *per capita* consumption of petroleum products in Europe and, enjoying also the highest standard of living, has the largest number of motor vehicles in proportion to population.

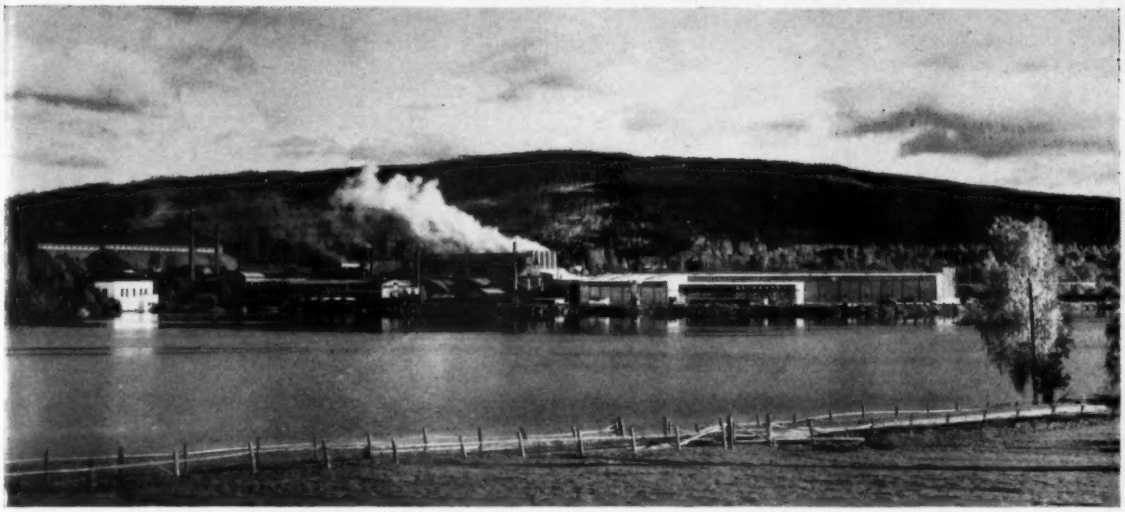
Part of Sweden's coal requirements is imported from Poland—over 1 million tons in 1954. These supplies consist chiefly of steam coal which is not readily available in adequate quantities in Western Europe, and recently Poland has repeatedly raised her coal prices to Sweden, presumably because rising quantities of coal are needed in Poland and in other Iron Curtain countries, and smaller quantities are available for export to the West. The landed price of Polish steam coal in Sweden—varying according to grades—is now about S.Kr. 104 to 109 (£7. 3s. to £7 10s.) per ton, compared with S.Kr. 82 to 86 in 1954. On a calorific basis it is now about 50% dearer than fuel oil. It is now expected that coal imports from Poland, also total coal imports, will drop still further and that the switch over from coal to oil will continue. Many industrial consumers have dual-firing equipment and—as actually happened on a substantial scale in 1948—they could without difficulty, revert to coal firing if and when this became again economically advantageous.

Hydroelectric power

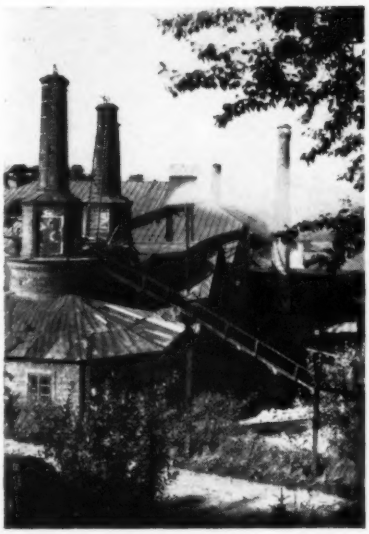
Waterfalls and rapids have since ancient times supplied power to mine pumps, iron works, flow mills, etc., and hydroelectric plants, which operate in all parts of Sweden, have made the country the most extensively electrified of any in the world.

Potential capacity of hydroelectric sources is estimated at 60 billion kwh. p.a. If this potential could be fully realised, Sweden could substitute electrical energy for all imported fuels. At the present rate of development, all available resources should be utilised by 1980. At the end of 1951, almost one-third (18.7 billion kwh.) of the potential was harnessed, to account for 95% of the electricity.

Flood-lighting of open-cast iron ore mines at night to permit all-night working.



Here, in a typical Swedish setting, is the steelworks of the Uddeholms company, at Hagfors.



View of the Iggesund ironworks.

Within the last ten years, the kwh. output obtained from water power has doubled. Present power plant capacity totals 3,680,000 kw., designed to generate 20 billion kwh. for 1952.

Of Sweden's 1,400 hydroelectric stations, the two largest are underground: Harsprånget on the Lule River in Lappland (350,000 kw.) and Kilforsen on the Fjällsjö River (240,000 kw.). Among the four plants that produce at least 1 billion kwh. each are also Trollhättan on the Göta River (220,000 kw.) and Krängede on the Indal River (210,000 kw.).

Though more than half of the electricity output is under private ownership, all the big power plants are united in a voluntary organisation under Government leadership in order to assure equitable distribution of the current throughout the country.

Iron and steel

Two branches of domestic steel production can be distinguished: one, based on charcoal iron, concentrates on high-quality grades for exports and domestic needs; the other, based partly on coke iron and mostly on scrap, produces regular grades such as structural and concrete reinforcement steels, beams, rails, plates and wire rods for domestic consumption. In 1951, quality steels made up 27% and commercial steel 73% of the total output volume.

The ores that have helped give the Swedish steel industry an international reputation have a very low phosphorus and sulphur content. The amount of phosphorus and sulphur in the ore does not have the same significance today as in former times, since metallurgical processes now in use can almost completely remove these elements in the manufacture of steel processes, which are still considered to yield the highest quality of steel. The Bergslagen ores (the famous 'Dannemora' ores) with their low phosphorus and sulphur content thus remain the principal source of raw material for the manufacture of quality steel, but some use is also made of ore of a similar quality mined in the far northern part of the country. The 1951 Bergslagen yield was 4 million tons, of which a quarter was processed domestically.

Sweden's largest ore deposits estimated at almost 2 billion tons of iron are, however, of high phosphorus content—up to 2%—and could not be used until the basic steel processes were introduced. Mining operations began at the close of the 1880s at Grängesberg, in the Bergslagen region, and production now exceeds 1 million tons p.a. Somewhat later, extraction of ore was begun at the extremely rich deposits situated at Kiiruna, Malmberget, and elsewhere north of the Arctic Circle. The Kiiruna field has proven reserves in excess of 1 billion tons. About 15 million tons of ore containing between 60% and 71% iron, but 1% phosphorus, are now being mined there, the major portion being exported. Iron ore accounts for more than 10% of Sweden's total export trade today.

The production of pig iron and steel ingots is based on purely chemical processes, and fuels constitute a most important cost factor in this industry. What was once an advantage, as long as charcoal was the only fuel, became a drawback when other countries changed over to coke. Sweden nowadays accounts for only 1% of world steel production, but is probably the only nation in the world possessing little or no coal resources which has been able to expand her steel industry considerably.

An important factor in making such an achievement possible was the leading part played by the Swedish steel industry in seeking ways to raise fuel productivity, and its pioneering work in other aspects of technical development. For example, the method of charging the blast furnace with sintered ore instead of lump ore was very significant. As early as 1910, electric furnaces were put into use in which charcoal and coke were utilised only

in the chemical reduction of the ore. Sweden's important water-power resources will be discussed later, but it should be noted that sharply increasing demands for electric energy make it rather unlikely that further development of electric furnaces will be profitable, except when periodic surpluses of power at cheap rates can be utilised. On the other hand, electric smelting of steel which is not so dependent on low electricity prices is a large and increasingly important consumer of power.

The high price of charcoal has prompted the steel industry to seek to replace charcoal pig iron with sponge iron, produced by reducing the ore without smelting. A Swedish invention, it reached a total annual output of 40,000 tons in 1951, but the opening of new mills will have doubled this figure. The industry has now managed to carry out the reduction with gases regenerated from coke and still retain a low percentage of sulphur and phosphorus in the iron.

Despite the high-tariff walls now common abroad, the manufacturers of high-grade steel—such as Sandviken, Uddeholm, Fagersta, Hellefors and Hofors—have been able to sell a large share of their output of finished steel products in foreign markets. Ordinary grades of steel made from ores containing a high proportion of phosphorus are produced exclusively for domestic markets, and during recent years there has been a sharp rise in production, accompanied by increased demand and lowered imports.

At Oxelösund, export harbour for phosphorus-rich ores from Bergslagen, there has for a long time been a plant producing pig iron with coke from its own ovens. Another important company, Domnarvets Järnverk, located near the Grängesberg deposits, has in recent years become one of Europe's most efficient steel producers. It utilises a combination of the basic Bessemer process and electric steel furnaces, and has the lowest fuel consumption in the world. During World War 2 a large pig-iron plant was built at Luleå which mainly uses the phosphorus-rich ores from the far north of Sweden.

Recently it was expanded to include both a basic Bessemer plant and a rolling mill. In contrast to the rest of the steel industry, this plant is owned by the Government. At the Domnarvet and Luleå steel mills large quantities of basic slag are obtained as by-products.

In the immediate pre-war years, 37% of all iron and steel output was exported; in 1951 only 12%. Quantitatively, imports are greater than exports—in 1951 about 74,000 tons of pig iron and 738,000 tons of commercial steel as against 68,000 tons of iron and 160,000 tons of high-grade steels —but exports exceed imports in value. The industry's expansion plans mostly affect commercial steel and will reduce imports by two-thirds.

Sweden's steel exports are confined to the higher grades and to highly wrought steel such as carbon and alloy (high-speed) tool steel, steel for the construction of machine, motor vehicle and aircraft parts, solid and hollow tube billets, ball-bearing steel-wire rods, etc.

The existence of steel works of this description has naturally been of great benefit to the rapidly expanding engineering and hardware industry in the country, and the larger steel works have departments for the manufacture of finished products of different kinds, such as heavy forgings, drop forgings, steel castings, tools and implements, etc.

The manufacture and export of ferro-alloys plays an important part and includes ferro-silicon, ferro-manganese and ferro-chromium.

RECENT PUBLICATIONS

Safety goggles. A 32-page booklet that gives details of their different types of safety goggles, as well as of their respirators and protective clothing, has been issued by Fleming Safety Goggles (division of J. & R. Fleming Ltd.).

High-polymer emulsions. An article entitled 'Composition—Property Relationship in High-Polymer Emulsions,' by J. H. W. Turner, F.R.I.C., and S. Hodgson, has been reprinted and issued in booklet form by British Resin Products Ltd.

Fans, blowers and exhausters. The Sturtevant Engineering Co. Ltd. have recently produced a 40-page illustrated booklet, No. 2206, which supersedes No. 2203, and which gives details of their fans, blowers and exhausters. Besides descriptions of the fans the booklet contains tabulated data concerning performances, dimensions, etc.

Fuel economy. In many furnaces, particularly intermittent furnaces, a considerable reduction in fuel consumption may accompany an equally considerable increase in output. It is the result of making sure that as much heat as possible goes into the charge and as little as possible into the furnace lining. The lining of a batch furnace has to be heated and cooled with every charge. To reduce the thermal capacity of the lining is therefore equivalent to reducing the lead. This and other considerations are discussed in a 4-page pamphlet from the Morgan Crucible Co. Ltd., which briefly describes the role of the M.I. range of refractories in reducing fuel costs.

The heating of nickel. Precautions to be taken and the procedure to be followed when dealing with nickel that is to be heated are discussed in a 48-page illustrated booklet that the Mond Nickel Co. Ltd. have brought out. The information has been gathered, over a period of years, from a large number of fabricators and users of nickel plant.

Chemical engineers. A brochure recently published by Petrocarbon Developments Ltd. gives an outline of the company's comprehensive engineering and consultancy service to the chemical and petroleum industries. It also shows examples of Petrocarbon-designed, -engineered and -erected plants.

Painting steelwork. A report issued by the British Iron and Steel Research Association and entitled 'The Painting of Structural Steelwork' details the results of an investigation started in 1945 by representatives of B.I.S.R.A. and the British paint industry into the performance of various paint schemes and the effectiveness of various methods of surface preparation. These prolonged tests were divided into four main groups. The first and second deal with priming paints, including metallic pigments and lead soaps; the third covers the technique of surface preparation and the use of metallic coatings; and the fourth the use of protective paints with tar or bitumen bases. Comparative exposure tests have been undertaken in an industrial atmosphere and a seaside atmosphere. A very large number of observations have been made over the years, and the report records these in detail.

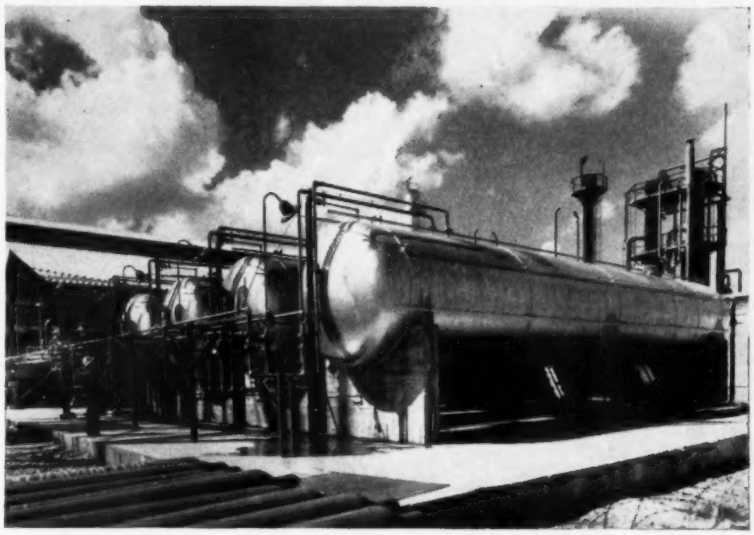
Fluorocarbon rubber. The properties, applications, compounding, vulcanisation and fabrication of *Kel-F* elastomer — a fluorocarbon rubber claimed to have outstanding resistance to heat and corrosion—form the subject matter of new companion brochures published by the M. W. Kellogg Co., U.S.

ISRAEL'S NEW AMMONIA PLANT

Self-Sufficiency in Fertilisers

A NEW plant which will have an annual output of 14,000 tons of anhydrous ammonia has been opened in Haifa, Israel. With this plant as an addition to the facilities of Fertilizers & Chemicals Ltd., Israel now produces all three primary fertilising elements—potassium, phosphorus and nitrogen—and becomes self-sufficient in fertiliser production. Potassium is obtained as potassium chloride from the Dead Sea works or as potassium sulphate from F. & C. Phosphorus is produced by F. & C. as superphosphate, and nitrogen as ammonia and ammonium sulphate.

The local production of ammonia and compounds of ammonia will save the equivalent of £15 million in foreign currency. In addition, a saving will be made on the importation of anhydrous ammonia, which was previously brought into the country in high-pressure containers.



Ammonia storage tanks at the new Haifa ammonia plant.

Production of ammonia

At Fertilizers & Chemicals, the following process is employed:

(1) **Sulphur removal.** Liquefied petroleum gas—mostly butane and propane—is obtained by pipeline from the C.R.L. refinery. It is treated under pressure, in the liquid phase, with caustic soda for removal of sulphur. The caustic soda is regenerated and re-used.

(2) **Re-forming.** The treated liquefied petroleum gas is vaporised and preheated. It is first passed through absorbent vessels for removal of any residual sulphur. Air, steam and gas are then mixed and pass through a series of reaction vessels filled with catalyst and maintained at high temperature. The reaction products are hydrogen, nitrogen, carbon monoxide, carbon dioxide and water. The reactants must be carefully pro-

Summary of Production at the Haifa Works

SUPERPHOSPHATE

The manufacture of superphosphate was started in 1949. Raw materials were then rock phosphate from North Africa and the U.S. and sulphuric acid produced by the company. With the discovery and exploitation of the phosphate mines in the Negev, the company switched over to local raw material and since 1952 no additional phosphate has been imported.

In summer 1951 the original batch process was replaced by a continuously working plant purchased under the first Export-Import Bank Loan Scheme. Since then, annual production has increased steadily up to a daily performance of 550 tons. About the end of 1954, exports of superphosphate were started to Mediterranean countries.

SULPHURIC ACID

F. & C. have two sulphuric acid plants. One, a small plant which uses sulphur imported from the U.S. or Italy as raw material, started operating in 1949. The production rate is 30 to 35 metric tons/day. The other plant is a large one, burning pyrites from Mediterranean countries or, alternatively, sulphur (as a result of alterations being effected). It started production in 1953 and produces, at full working capacity, 250 to 280 tons/day.

The product of these plants is used in the manufacturing process of various fertilisers in other F. & C. plants (superphosphate, potassium sulphate, ammonium sulphate, di-calcium phosphate, etc.). A certain quantity of sulphuric acid is also sold to local industry for the production of detergents, canned food and batteries. Until recently, part of the sulphuric acid was exported, mainly to Turkey.

POTASSIUM SULPHATE

The plant, which was ordered already in 1946, together with the first sulphuric acid plant, was erected only in 1955. Erection work was stopped in 1948 when the potash works at the northern end of the Dead Sea were wrecked during hostilities, the potash being the main raw material in the production of potassium sulphate.

Potassium sulphate is produced by the reaction of potash with sulphuric acid at high temperature (500° C.). In addition to the potassium sulphate, hydrochloric acid (in gaseous form) is produced. These gases are absorbed in water to produce 30% hydrochloric acid which, in turn, is used in the manufacture of di-calcium phosphate. Yearly production of the plant is about 10,000 metric tons of potassium sulphate, which is partly earmarked for export.

DI-CALCIUM PHOSPHATE

The main raw materials are phosphate and hydrochloric acid (mentioned above). The plant's capacity is 8,000 tons p.a., about half of which will be exported.

PHOSPHORIC ACID

Phosphoric acid is produced by reaction of sulphuric acid and phosphate. It will be used mainly in the production of enriched superphosphate and/or triple superphosphate. The acid produced in the plant is of a quality of 30% P_2O_5 and can be concentrated to 50% P_2O_5. The plant's annual capacity is 7,500 tons, based upon 100% P_2O_5.

DESIGN

The nitric acid plant and the superphosphate plant were designed by La Société Belge de l'Azote and l'Etablissements Kuhlmann (France), respectively, as well as by F. & C. engineering staff.

portioned in order to achieve the desired ratio in the product.

(3) **Compression and purification.** The re-formed gas is subjected to compression, in six stages, to a pressure of 5,000 p.s.i. (350 atm.). Between stages the gas is passed through purification units for removal of carbon dioxide and carbon monoxide respectively. In the purification units the carbon oxides are removed by scrubbing with different liquids. These liquids are each regenerated and recycled, giving carbon dioxide and carbon monoxide as by-products. The gas from the final stage of compression is a mixture of hydrogen and nitrogen.

(4) **Synthesis and storage.** The mixture of hydrogen and nitrogen, at 5,000 p.s.i. pressure, is passed through another catalyst to form ammonia. Since only partial conversion takes place, the unreacted gases are recycled by means of recirculating compressors. Ammonia in the gas stream is liquefied under pressure, by cooling, and is sent to storage. Storage is kept at 200 p.s.i. pressure.

(5) **Refrigeration.** To carry out the various functions required, the ammonia unit has its own refrigeration facilities. Refrigeration compressions are employed for recompressing ammonia gas from the refrigerating units.

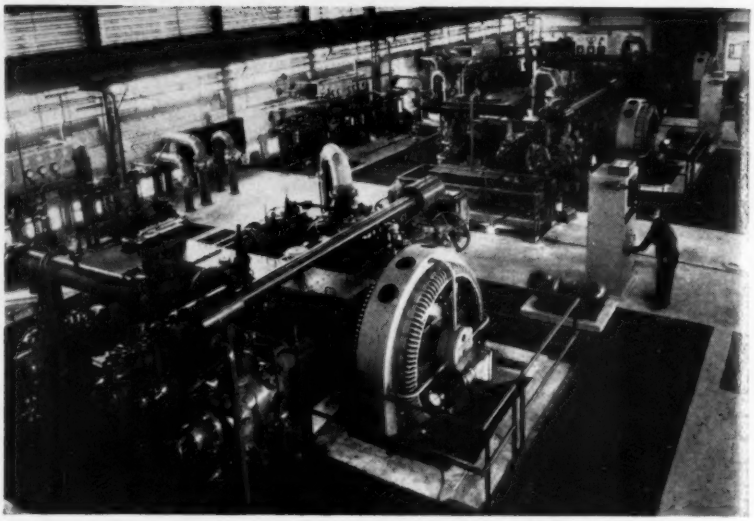
Engineering and design

The ammonia and ammonium sulphate plants were engineered and designed by the Chemical Construction Corporation of New York, whose personnel supervised erection and started up the plant. A number of F. & C. plant operators were trained by the Chemical Construction Corp. on operating plants in the U.S.

Utilisation of ammonia

The plant operates 24 hr./day without shut-downs. For the time being, ammonia will be utilised mainly for the manufacture of ammonium sulphate (obtained by reaction with sulphuric acid), of which about 50,000 tons will be produced annually. Additional ammonia will be employed as fertiliser in other forms, while anhydrous ammonia will be sold to ice factories and chemical plants.

Fertilizers & Chemicals Ltd. have rapidly developed into Israel's largest industrial enterprise, the company being founded in 1946 by Palestine Potash Ltd., the Palestine Jewish Colonisation Association (P.I.C.A.), Palestine Economic Corporation of New York and Africa-Palestine Investments Ltd. The founders were, in 1948, joined by Hamashbir Hamerkazi.



Inside compressor house of ammonia plant.

Irradiation of Special Polythene Gives New Electrical Insulation

EXPOSING a specially formulated polythene plastics material to a beam of electrons moving at almost the speed of light has produced a new electrical insulation with greater tolerance for heat. This was recently announced by the Sequoia Process Corporation, of Redwood City, U.S., and the Stanford Research Institute, Menlo Park, California, U.S., who have jointly developed the new technique for irradiating the special polythene.

Among possible future non-electrical industrial uses of the new material is its use as tubing for the transport of hot fluids and certain chemicals.

Described as a major development in the relatively new field of radiation chemistry and in the technology of electrical insulation with polyethylene, the joint research effort was begun early in 1955 and the radiation study entailed exposure to radiation by S.R.I.'s cobalt-60 source of gamma rays of some specially prepared wire samples insulated with modified polythene. Unlike some commercial plastics which are degraded by radiation, the new material is improved by the process.

The new material is being marketed under the trade name *Hyrad* by Sequoia, whose Redwood City main plant is already in quantity production. *Hyrad* is claimed to be specially adaptable as a jacketing material for wire and cable in such high-temperature environments as jet aircraft and various electronic components. Another feature is its elastic 'memory,' which makes possible a tight shrink-fitting under considerable tension for insulating capacitors, lugs, splices and soldered joints.

The source of process radiation at the Sequoia Redwood City plant is a General Electric electron beam generator. Radiation of *Hyrad*-coated wire entails passing the strands on pulleys over a set of rollers and under the beam. Each segment of wire follows the same path through various beam intensities and thus receives the same amount of radiation.

To Authors of Technical Articles and Books

The Editor welcomes practical articles and notes on chemical engineering and related subjects with a view to publication. A preliminary synopsis outlining the subject should be sent to The Editor, CHEMICAL & PROCESS ENGINEERING, Stratford House, 9 Eden Street, London, N.W.1.

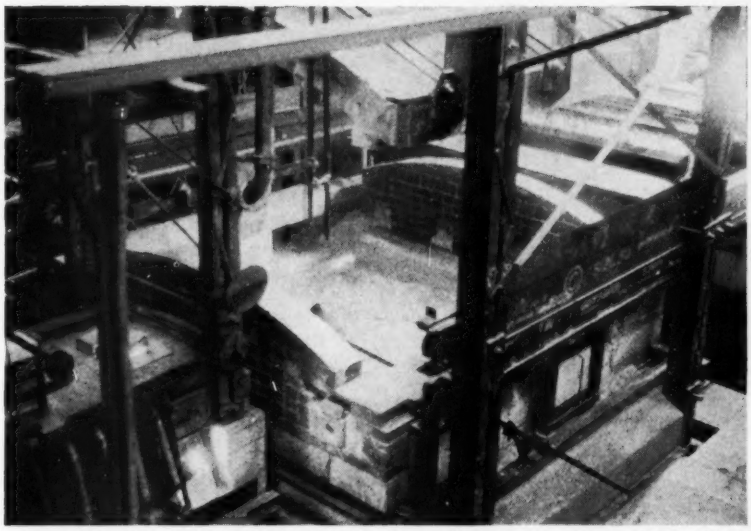
In addition, the Publishers and Editors of the Leonard Hill Technical Group are always ready to consider technical and scientific manuscripts with a view to publication. Correspondence should be addressed in the first instance to the Book Production Manager, at the above address.

An All-Electric Furnace for the Glass Industry

A new type of all-electric glass furnace is claimed to make possible a considerable reduction in installation, operating and maintenance costs.

EVER since it was first discovered that at a certain temperature the resistance of glass would decline sufficiently to allow the passage of an electrical current through it, it has been theoretically possible to melt glass by electrically developing heat inside it, instead of by applying heat to the surface by conventional methods. Only fairly recently, however, has this type of electrical melting been seriously studied as a practical alternative to fuel-fired furnaces. British Heat-Resisting Glass Co. Ltd. (manufacturers of *Phoenix* glass ovenware) have recently developed an all-electric glass-melting furnace and production units are in daily operation at their works in Bilston, Staffordshire.

The furnace, which the company is making available to other glass manufacturers, can be used with nearly all types of commercial glass. In one form it is hoped to match up with standard automatic bottle-making machinery.

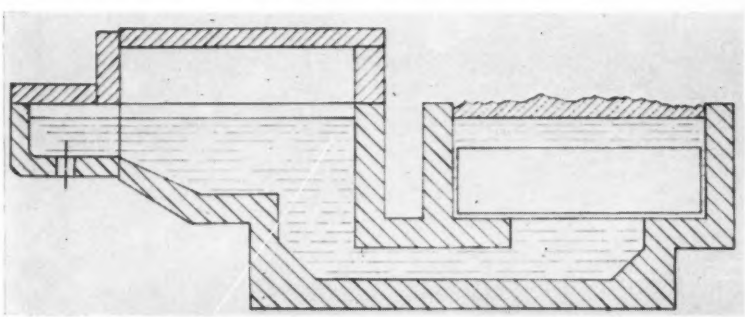


The melting chamber of the all-electric glass melting furnace from above. Right at the top of the picture can be seen the furnace's crown in its raised position. When the furnace is started up, this is lowered and heat is applied by flame to the glass raw materials until they have melted sufficiently to allow the free passage of the electric current.

High thermal efficiency

A major advantage claimed for the furnace is very high thermal efficiency. The designers point out that the heat losses from a conventional furnace are very large; even under optimum conditions anything up to 95% of the heat generated is wasted in heat losses. Compared with this, the new all-electric furnace loses only about 40 to 50% and some further improvement on this is expected.

There have been, in the past, a number of attempts to operate furnaces of this kind, notably in Scandinavia, France, Germany, Switzerland, the United States and Russia. They fall into two types. In the first, the raw material enters one end of the furnace and passes horizontally through a melting zone and refining zone to a working chamber. In the other type, concentrating electrodes are used and the melting and refining may take place in the same chamber or in different chambers.



A cross-sectional drawing of the all-electric glass melting furnace. The molten glass flows from the main melting chamber on the right of the picture, through the controlled cooling channel to the forehearth.

The all-electric glass-melting furnace that has been developed in Britain has, as one of its main objectives, the reduction of heat losses in any form to a minimum. Heat is engendered in the glass in the six-sided rectangular melting chamber by electrodes on two of the facing walls. The raw batch is fed in at the top and forms a carpet over the entire surface; this, while allowing the gases given off by the melting glass to pass through it, forms an insulating ceiling over the melting process.

The glass is passed downwards through a zone of maximum temperature and, as its resistance during the melting is higher than that of refined glass, the electrical current lines will tend to concentrate towards the bottom of the chamber and so provide a zone of greater heat just where it is required for the final refining of the glass. The lower-grade heat given off by the glass particles within this zone is transmitted to the surface where it is still sufficiently high to melt the underside of the batch crust. Thus as the glass is withdrawn from the base of the

melting chamber, so is melting glass liquefied from the underside of the batch crust, which is replenished by fresh material as it becomes used up.

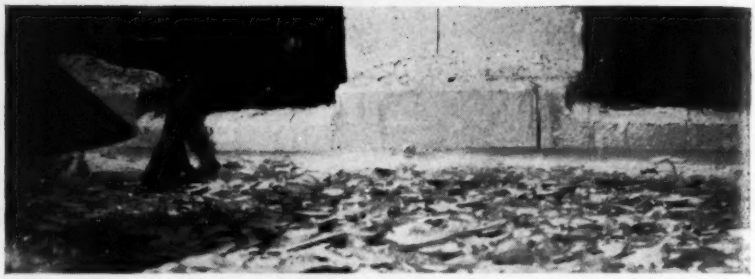
Control apparatus

The conception requires the precise and flexible control of a substantial power input at uniquely high temperatures. The electrical apparatus feeding the electrode faces in the melting chamber consists in its simplest form of three power transformers, transforming the mains voltage up or down to that required. Each is connected with an infinitely variable voltage regulator. This regulation is important and can, in fact, be achieved either by means of stepless voltage regulators or by saturable reactors. The former are better, as they provide a less peaky wave form to the current cycle passing through the glass.

Once such a furnace is installed, it is calibrated carefully, the power required for a given rate of melting for a specific glass being critical. Once calibrated, however, the furnace becomes self-regulating within limits of 5% on either side of the conditions set for any rate of throughput, tending to hunt towards the appropriate conditions rather than away from them. This, it is pointed out, greatly simplifies operation. Moreover, a method has been devised whereby the regulation of the electric currents and the timing of the batch charger can be controlled automatically by an electronic computing device which makes use of radio-active strontium and a sensitised counter.

Low installation costs

The inventors of the new furnace believe that, apart from its economy in operation, due to its conservation of heat, it has many other advantages over the fuel-fired type. It requires much less space, for instance, in all three dimensions, and no special building is needed to house it. This, coupled with the fact that such a furnace can be installed in only six weeks instead of the six months or more necessary for a conventional furnace, brings down the initial cost enormously. Whereas a conventional furnace producing 60 tons/day of bottle glass would cost around £60,000 to build, an all-electric furnace of the same capacity would cost only about £24,000. Similarly, maintenance costs are very much lower. By comparison with a fuel-fired furnace, the all-electric one needs only one-quarter of the amount of refractory material and the campaign life is normally more than 12 months. Because of the few refractory blocks which need replacing at the periodic rebuild, this takes a much shorter time, with consequent savings in labour and in idle time.



Some measure of the thermal efficiency of the all-electric glass melting furnace can be gauged in this picture, as an operator actually touches the surface of the batch materials melted in the furnace.

If the new furnace is all that is claimed, it would seem likely that conventional furnaces will eventually be replaced with all-electric furnaces for glass melting.

Book Review:

Stainless Steels

This book* has been written to provide, for the user of Cr-Ni austenitic stainless steels, a simple guide to their properties, fabrication, applications, etc. In the preface the author states that the book is essentially a handbook for the practical man, although sufficient theoretical matter has been included to give a necessary background to the subject. The first chapter is, therefore, devoted to the physical metallurgy and structure of these steels.

The one criticism that can be made of this otherwise excellent book is that, in view of the author's statement in the preface, this chapter would have gained a great deal in clarity if it had been extended, as it is extremely difficult to do justice to this fundamental aspect of the subject in six pages.

The following chapter deals with the historical development of stainless steels and considers in detail the problem of intercrystalline disintegration. There is a most interesting section on the relative merits of the disintegration tests used in America and this country in regard to the stabilisation of carbides in these steels by additions of columbium and titanium.

Chapters 3 and 4 deal with melting and casting, hot and cold working, annealing and stress relieving, descaling, machining, grinding and polishing, welding, etc. Mechanical properties at normal, elevated and sub-zero temperatures are considered in the following chapter, which is well illustrated by data in the form of tables and graphs.

There is an excellent chapter on the corrosion resistance of these alloys and the various types of corrosion that may be encountered in service, such as pitting, deposit and crevice attacks, galvanic corrosion, stress corrosion, etc. Attached to this chapter is a useful appendix which gives a coded rating of the resistance of typical steels to various corrosive environments. A novel and welcome section in a book of this nature is the final chapter which deals with the chemical analysis of these alloys.

Written by a recognised authority, this book is without doubt an excellent concise account of the metallurgy of the chromium-nickel austenitic steels and contains a great deal of information which will be of value to the practical man. In addition, it can be recommended to the student and the qualified metallurgist and to the chemical engineer. L. L. SHREIR

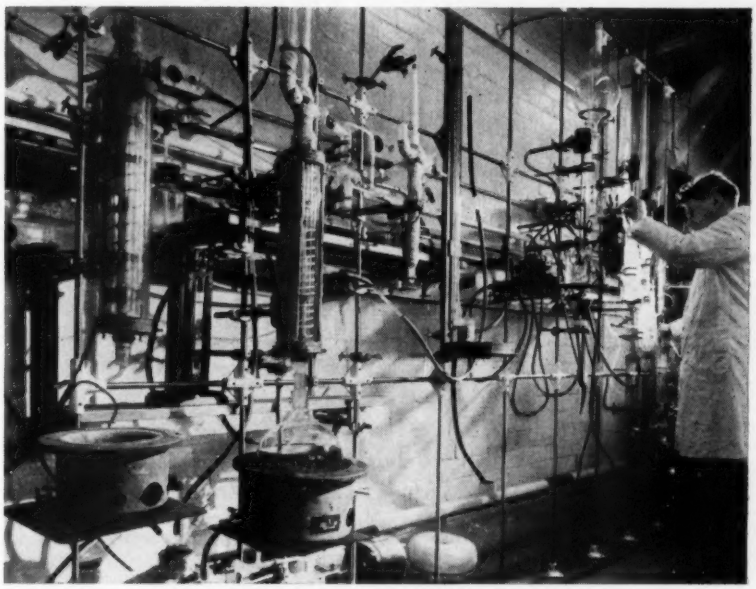
**Chromium-Nickel Austenitic Steels* by F. H. Keating, Butterworths Scientific Publications, London, 1956. Pp. 138 inc. index, 25s.

New Laboratories for Monsanto

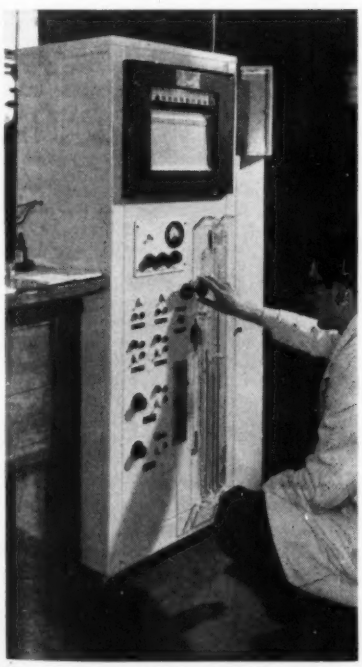
Laboratories for work on chemical, chemical engineering, physical and technological problems, as well as a radiation laboratory, are included in new research facilities of Monsanto Chemicals Ltd., opened at Newport, Mon., recently. These laboratories are briefly described below.

A SPECIALLY equipped laboratory for the study of chemical and physical changes arising from nuclear radiation, believed to be the first industrial radiation laboratory in Britain, is an outstanding feature of the new research laboratories of Monsanto Chemicals Ltd. at Newport, Mon. The new facilities are, in the main, those of a well-equipped laboratory of conventional design, but the radiation laboratory, housed in a small building standing apart from the main block, represents a departure from conventional research into a new and highly speculative field.

The laboratories have been designed to augment the already extensive research facilities of the company located at the Nickell laboratories—opened at the Ruabon, Denbighshire, factory in 1949—and the applicational research laboratories at Fulmer Hall, Buckinghamshire, opened in 1951. Named the Rideal laboratories in honour of Prof. Sir Eric Rideal, F.R.S. (consultant to and, until recently, a director of Monsanto Chemicals Ltd.),



Equipment used in process research at the Monsanto laboratories, showing conventional distillation apparatus and a laboratory continuous reactor.



Control panel of a gas chromatograph—one of the latest techniques.

the laboratories have been designed to provide the company with further facilities for physical, chemical and engineering research, applied in the first place, particularly but not exclusively, to the polymer field.

Chemical and engineering research

The chemical and chemical engineering research laboratories are situated in the two-storey section of the main research block. Two chemical laboratories have been provided—one on each floor of the double-storey area. Each has direct access to the chemical engineering area which occupies the remainder of this part of the building.

These laboratories have been laid out as general-purpose laboratories. In each, generous fume cupboard facilities have been provided, and one wall has been provided with services but no bench, to facilitate the setting up of equipment grids. Each laboratory has an instrument room to house balances and similar equipment.

The ground-floor laboratory will be engaged chiefly, though not exclusively, in research concerned with improvements to existing Newport products and manufacturing processes. The first-floor laboratory will be used for longer-term research in the organic and physical chemical fields. From the work of these laboratories will come some of the chemical engineering problems, representing the second stage in the development of a new product or a new manufacturing method, which will be the responsibility of the chemical engineering research laboratory.

The chemical engineering laboratory, which is treated as a flameproof unit, is provided with ring services on both floors. Wide chequer-plate platforms have been used to form the first floor, leaving a central well. This permits the use of such tall equipment as distillation columns, and the construction of experimental plants on two levels. The flexibility of operation obtained from this arrangement of services and floors is essential to the efficient function of such a laboratory.

The physical analytical research laboratory, which provides an essential service to the chemical research laboratories on the application and development of physical-analytical methods, is still housed temporarily in an old

building some distance from the new laboratories. Equipment in this laboratory includes a Grubb-Parsons infra-red spectrograph, a Hilger ultra-violet spectroscope and a vapour-phase chromatograph.

New materials resulting from the work of these laboratories will subsequently be studied from the point of view of physical properties and technological evaluation, in the physics and technological laboratories.

Physics and technological laboratories

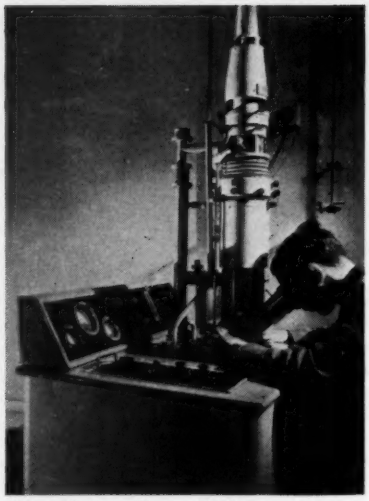
Another group of laboratories consists of a physics laboratory, rheological laboratory, polymer technology laboratory and precision workshop. The laboratories are equipped to deal with all aspects of the work involved in the study and development of polymers, from chemical products in the crude state to finished products in forms suitable for use by the moulding and other plastics conversion industries.

Two notable items of equipment in the physics laboratory are a recording torsion pendulum and its associated electronic equipment, used for the investigation of the dynamic physical properties of polymers, and a Sjostrand ultra-microtome. This instrument is used in the preparation of electron microscope samples, and is capable of cutting sections as small as 100Å.

Radiation research

The radiation laboratory has been designed primarily to permit study of the effect of γ-radiation on materials such as plastics and also to use the radiation for promoting chemical reactions. In addition, the facilities should permit the use of small β sources for similar types of studies.

The initial design provides for work with two separate 100-curie cobalt 60 sources, but small modifications should enable studies to be made with up to 500 curies of this isotope and 1,000 curies of caesium 137.



The Metropolitan Vickers electron microscope which can produce photomicrographs of up to 150,000 diameters.

Certain hazards are involved when working with these fairly high levels of activity. Adequate safety precautions have been incorporated in the design, but it has been deemed advisable to limit the number of personnel entering the laboratory by constructing it in a building separate from the company's main research laboratories. In designing the facilities, the maximum permissible level of radiation to which research workers will be exposed has been taken as 0.3 rad./40 hr. (= 1 tolerance), as recommended by the International Commission on Radiological Protection.

Shield design

In order to reduce the level of activity in the laboratory proper to below 1 tolerance, it is necessary to have at least 42 in. of dense concrete around a 100-curie cobalt 60 source on any direct line to the outside of the shielding. At Newport a greater thickness is used.

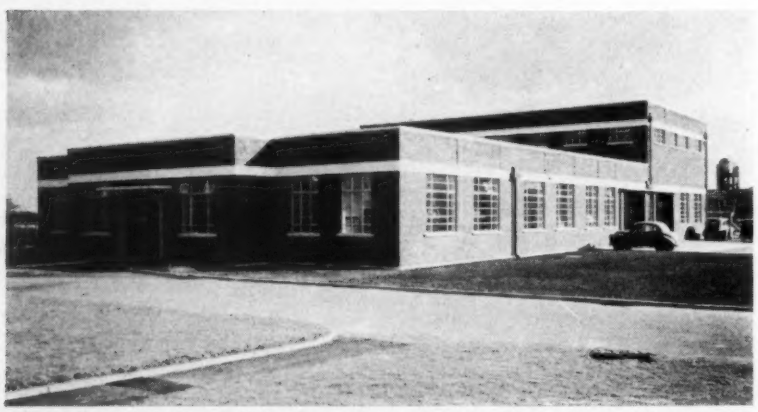
Briefly, the shield consists of a large cube of concrete, in the centre of which the source is situated when it is not in use. The source itself is contained in a metal cylinder about 1-in. diameter by 5-in. long and is attached to a flexible steel cable running in a tube which emerges at the front of the cube. On the front face of the shield are controls which enable the source to be driven mechanically into the working space, which is located at the back, or far side, of the concrete cube.

It is here that experimental apparatus is set up, and the experiment is commenced when the source is driven forward into the working space. The working space itself must therefore be shielded from the laboratory proper by further concrete walls, and access to it is obtained through a short passage in the shielding. This passage is terminated by a stout steel gate.

Provision has been made to install sources of various dimensions and source-drive mechanisms of various standard designs. Mirrors permit observation of the working space from the gate (which is closed and locked when the source is in use) and service ducts have been provided for bringing such items as thermocouple leads, or remote pressure indicators, to the front surface of the concrete cube.

In addition, the alternative-access plugs enable the source to be used for certain purposes when it is in its rest position at the cube centre. This can be useful if elaborate equipment is being set up in one of the working spaces, since it enables full use to be made of the sources at all times.

Safety in the operation of the shields is achieved by a system of interlocks between the drive mechanism moving the sources, the locks of the entrance gates and the side plugs.



The Rideal laboratory building from the north-west. The radiation laboratory is housed separately.

Research and development studies using γ-radiation

As indicated above, two distinct types of study are to be made, although in a given experiment both effects are often present together and have to be separated or allowed for.

(*a*) It is now well known that γ-radiation can bring about interesting and sometimes valuable changes in the properties of materials. These changes have been particularly studied in the field of plastics and, as new plastics materials come forward, they

in turn will be examined under the influence of radiation. The effects produced reveal the value of the sample as a structural material in high-intensity radiation fields, and it is sometimes found that specifically valuable properties may be produced.

(*b*) Radiation can often be used to replace heat, light or catalysts in promoting the chemical reactions which are the basis of a chemical industry's operations.

In order that the use of radiation shall be an economical proposition for such purposes, it appears that one of the following conditions must be met:

(1) A large amount of chemical reaction must be accomplished per unit of γ-radiation absorbed by the system.

(2) A product must be produced with some 'special' properties compared with that produced in the reaction as normally carried out.

(3) A material must be produced which could not normally be obtained at all (*e.g.* because of its thermal instability).

The field of plastics, in which Monsanto is already a substantial manufacturer, appears at present to offer uses for γ-radiation under at least two of these headings.

Miscellaneous applications of radiation

Although Monsanto's programmes of work put considerable emphasis on the production of plastics with new and interesting properties, prepared by use of γ-radiation, they are also interested in making use of the energy for a wide variety of other reactions. These include alkylations, halogenations, oxidations and isomerisations.

In the present state of knowledge in the field of radiation chemistry, it is felt desirable to examine as wide a range of reactions as possible, for it is not yet possible to predict just exactly what reactions may occur, nor what properties a given product may have. In particular, the yield of reaction product per unit of radiation absorbed is still a factor which can only be determined by experiment. From the long-term point of view, this is one of the most important economic factors.

Process Plant Dynamics

INSTRUMENT ENGINEERS DISCUSS AUTOMATIC CONTROL STUDIES

A CONFERENCE on 'Plant and Process Dynamic Characteristics,' organised by the Control Section of the Society of Instrument Technology, was held at the university engineering laboratory, Cambridge, recently. The theoretical prediction and experimental measurement of the dynamic behaviour of chemical and other plant is necessary in order to make the best use of automatic controls. The purpose of the conference was to bring together various groups working on this subject, and those who will benefit from the results, so as to report work in progress and provide an opportunity for informal discussion.

In his opening address outlining the objects of the conference, Dr. G. L. d'Ombrain (Battersea Polytechnic) made a plea for standard presentation of frequency-response data. In the ensuing discussion there was a general preference for standardising on gain, phase advance and frequency rather than attenuation, phase lag and period, but no one form of presentation could be used to the exclusion of all others.

Dynamic behaviour of chemical plant

Mr. A. H. Horton (I.C.I. Ltd.) described the frequency response of an experimental jacketed pan to variations in flow of heating steam, for heating by direct condensation or by water circulating through the jacket and through a condenser. In both cases there was a continuous flow of water through the pan, and the contents were well agitated. A set of differential equations representing the system were found to predict the dynamic behaviour once the heat-transfer coefficients had been determined experimentally from the steady-state behaviour. (This pattern of experimental determination of static behaviour followed by theoretical prediction of dynamic response appeared in several of the conference papers; it is evident that a completely theoretical treatment of problems involving boundary layer properties is not yet possible.)

Mr. R. L. Day (I.C.I. Ltd.) described a similar study of a distillation-column reboiler. An experimental single-tube reboiler, with natural recirculation and fitted with a vapour restriction to simulate the presence of a distillation column, was used for frequency-response measurements. The low-frequency behaviour could be adequately represented by a much simplified theoretical model of three transfer stages, and the equations derived for this system were expected to apply to other types of reboiler, and to heating vapours other than steam.

Mr. W. L. Wilkinson and Dr. W. D. Armstrong (Cambridge University), and Dr. H. Voetter (Royal Dutch/Shell laboratory) gave papers describing experimental and theoretical work on laboratory distillation columns. The former authors studied the transient response of a column, operating at total reflux, to a step change in the composition of the vapour entering the column from the reboiler; the second paper dealt with the transient and frequency response to disturbance in the feed composition. Promising results have been obtained by assuming equilibrium is attained at each plate in the column, and Dr. Voetter was able to define a 'figure of merit' for the performance of a binary-mixture distillation column under fairly general conditions. In the discussion, the use of computers was advocated as an aid to the design of distillation columns, since they would enable a large number of possible designs to be evaluated both statically and dynamically.

Dr. K. Hengst (B.A.S.F., Ludwigshafen) reported some preliminary experimental work on the distribution of temperature, and its effect on control performance, in an operational distillation column of the bubble-cap plate type.

Mr. M. W. Geerlings (Delft Technical University) dealt with the dynamic behaviour of neutralisation processes, and of the glass electrodes used for measuring *p*H. Experiments have shown the importance of adequate mixing of the reagent with the liquid to be neutralised, and have revealed some striking variations in sensitivity of glass electrodes for certain types of reaction, depending on the average *p*H value. This, and the shape of the

neutralisation curve, makes the system highly non-linear, and the practice of *p*H control should benefit from these experimental studies. The mechanism of ion exchange at the boundary layer is not yet sufficiently understood for theoretical prediction to be possible.

The day's proceedings were concluded with an informal contribution by Dr. J. H. Westcott (Imperial College) on the determination of plant characteristics from random inputs. The mathematical techniques evolved for investigating the response of servo systems subjected to 'noisy' inputs could be used to analyse plant under operational conditions, without the need to inject disturbances. This approach might appeal to plant managers, and has the further advantage that the response is treated in terms of actual and not idealised disturbances.

Automatic control in the process industries

The papers presented on the second day were more diverse, beginning with a report by Messrs. G. H. Thorndike, R. T. D. Richards and P. D. Jowett (Wool Industries Research Association) on the experimental study of a woollen carding engine. In this work a very complicated mechanical process was evaluated in terms of a particular measured variable (the density of carded fibre as measured photo-electrically) and expressed as a transfer function for control purposes. In this application, as in many old established industries, automatic control had to be relatively cheap or else show a significant improvement in quality, because of the low cost and long life of the plant.

Messrs. N. Ream (N.P.L.), R. H. Tizard (N.P.L.) and D. S. Townend (B.P. Ltd.) described the application of an electronic analogue computer to the study of a level control system operating on a refinery distillation column. This particular system had been selected for study because, although its performance was noticeably poor, the effects were not serious enough to have been corrected by trial and error in the normal way. The observed behaviour was reproduced on the analogue, which was then used to interpret the behaviour and to examine the effects of possible improvements. In the discussion the paper was criticised for treating in considerable numerical detail a problem whose qualitative solution would be obvious to a process control engineer; the authors maintained, however, that the investigation showed the way to analysing complicated systems with the help of analogue computers, and had given a useful insight into the experimental methods suitable for analysing the dynamic behaviour of existing plant, and the limited extent to which the instrumentation found on the plant can be relied upon for this purpose.

A paper by Mr. J. Endtz, Dr. J. M. L. Janssen and Mr. J. C. Vermeulea (Royal Dutch/Shell laboratory) described the techniques used in the authors' organisation for measuring dynamic response of units of plant. The test equipment included a sine-wave generator, with twelve-channel recording; this was described and examples were given of frequency-analysing a refinery furnace and a pilot distillation column. The transfer-function properties of the furnace were assigned to specific physical processes taking place therein and an electronic analogue representation was used to select a control system which would respond satisfactorily to the actual disturbances present; the distillation-column results were used to compared theoretically the effectiveness of different types of control.

Messrs. J. Lewins and R. H. Macmillan (Cambridge University) described some simple formulae for controller settings in a closed-loop control system which result from representing the plant by an exponential lag together with a pure time delay. In the discussion, it was agreed that simple design rules were useful in this connection, but doubts were felt regarding the 'standardisation' of disturbances in process systems.

Finally, Mr. C. A. Laws (Elliott Bros.) spoke on the use of some 'data reduction' equipment as a tool in plant analysis.

Technical assistance for gas users

One of the greatest advantages of an integrated gas industry has been its vastly improved ability to render excellent technical service to its users in the industrial and commercial fields. To support this claim, the Gas Council, in a pamphlet entitled 'Promoting Fuel Economy in Industry,' has given examples of advice given to industrial gas engineers through area gas boards which has resulted in increased productivity and reduced fuel usage.

In one case a battery of heat-treatment furnaces was being converted from producer-gas firing to town gas. These furnaces were natural draught with recuperators built under the hearth. The flue pull was obtained by continuous stacks some 40-ft. high. The firm was working these furnaces intermittently and after a weekend they required from 24 to 48 hr. to reach working temperature. During the conversion to town-gas firing, pressure air eductors were fitted to the flues. Now they reach working temperature in 6 hr., even after a shut-down of several days. The effect upon increased output was considerable.

For pressure-air or air-blast burners some type of automatic gas-air proportioning device should be used. By addition of these and other burner modifications to heating glass tank feeders at a glass works the gas consumption was reduced by 26,250 therms p.a., or 7½%.

Other tests were carried out on two lead hardening baths. The first was of conventional design fitted with low-pressure burners. This raised 1,150 lb. of lead from 150 to 890°C. by the use of 10.42 therms of gas. The second bath was designed by the board, incorporating insulating refractory, a post-aerated burner with pressure air and recuperation. This second bath raised the same quantity of lead through the same temperature range for 4.9 therms.

Handling Engineering Contracts for the Process Industries

All over the world today vast sums of money are being spent on engineering for the process industries and in Great Britain alone annual expenditure is about £100 million—a total divided more or less equally between the petroleum and the chemical and related industries.

One installation, involving extensive work in all branches of engineering, may well run into millions of pounds, and such projects need a large and complex organisation for their efficient handling. In general, chemical and petroleum manufacturers find it more satisfactory and economical to hand the work over to a firm of specialised chemical engineering contractors.

The story of such an organisation is a fascinating one and is told with admirable skill in a 64-page illustrated book entitled 'Engineering for the Process Industries,' which has been produced by W. J. Fraser & Co. Ltd. This splendid publication takes the reader behind the scenes of the W. J. Fraser organisation and shows how the company handles its various contracts. The company supply process plant, on any scale, from the individual item to the complete factory or refinery unit.

ADHESIVE TAPES FOR MARKING CHEMICAL CONTAINERS

Adhesive tapes — in effect self-adhesive labels in roll form—are available with attractive appearance, high resistance to abrasion and ability to adhere to unusual surfaces, and they can be made inherently resistant to both weather conditions and to many types of solvents and oils. Because of these properties they are a valuable aid to the chemical manufacturer, not only for normal labelling with the brand or manufacturer's name, but in particular in meeting the various legal or semi-legal requirements for transport and other authorities.

Nowadays even large drums are often given a first-class appearance either by lithography or by screen printing, and printed self-adhesive label tapes having a naturally glossy and lustrous appearance marry perfectly to lithographed surfaces.

Many chemical products are packed in 40- to 45-gal. drums and these are usually stood vertically on lorries or railway wagons. Inevitably loaders walk on these drums when a second layer is stacked so that markings are removed or defaced by the abrasive action of heavy boots. Printed self-adhesive label tapes are strongly resistant to this form of defacing.

The destructive effect on normal markings of many chemical products led one company, Industrial Tapes Ltd., of London, to work out, in conjunction with leading firms in the industry, a series of label tapes with a permanent transparent screen laminated over the printed surface. Various types are now made which are claimed to withstand the action of a wide range of solvents, oils, etc. A subsidiary advantage gained here is that the labels need no drying, and containers can be filled immediately after labelling.

Cost factors

In considering the cost of printed adhesive tape labelling several factors enter apart from the unit cost per label. Even unskilled labour is expensive, and the packaging department needs to consider: (1) speed of application; (2) space taken up in applying markings; (3) the space occupied by pre-marked packages; and (4) the amount of ancillary material required. Self-adhesive tape labels offer considerable practical advantages in most of these respects, and it has been found that operating economies invariably more than counter-balance any price differential between the new form of tape labelling and older methods.

Consideration of these factors led one company (British Industrial Solvents, a division of the Distillers Co. Ltd.) to introduce self-adhesive tape labels for standardised barrel marking. Previously, each barrel was weighed and filling carried out after calculating the sum of net weight and tare. Twenty-seven tape strips were printed to cover 27 tare weights (87 to 113 lb.), the remaining figures (net and gross weight) being preprinted on the tape label.

Thus the barrel weigher simply selects by number a label tape corresponding to the tare weight; the barrel is labelled and passed to the filler who reads off the gross weight and fills

This dispenser carries gross tare and net weight labels in roll form to provide for a range of tare weights from 87 lb. to 110 lb. at 1-lb. intervals.

accordingly. No calculation is required on the filling floor, and it is stated that errors have been entirely eliminated, quite apart from an appreciable gain in output.

The standard warning labels scheme fostered by the Association of British Chemical Manufacturers for the marking of containers of hazardous chemicals makes use of a standard label closely specified as to overall size, type size and general layout. Its purpose is to protect all handlers right through the chain of filling to ultimate usage, and the scheme has the backing of H.M. Chief Inspector of Factories. The label is required to be black and white, and many of these are now most attractively produced in self-adhesive label tapes, in many cases with an additional printing for the characteristic house mark or brand name.

Chemistry and Medicine

Chemical engineers hear eminent surgeon's views

The need to step up cancer research from the chemical and biochemical side was one of the subjects touched upon by Sir Cecil Wakeley, Bt., K.B.E., C.B., past president of the Royal College of Surgeons, in his speech as chief guest at the annual dinner of the Chemical Engineering Group of the Society of Chemical Industry.

Speaking of medicine's debt to chemistry, Sir Cecil pointed out that, to mention only a few instances, anaesthesia, antiseptics and antibiotics had completely changed surgery.

Sir Cecil was convinced, having worked in cancer research for 40 years, that the cure of cancer was just round the corner and that the cure would be a chemical substance which, when injected into the blood stream, would kill every cancer cell.

Other guests at the dinner included Mr. John A. Oriel (president, Institution of Chemical Engineers), Dr. J. C. Hudson (vice-chairman of the Corrosion Group of the S.C.I.), Mr. F. A. Greene (hon. treasurer of the Institution of Chemical Engineers), Mr. F. E. Warner and Mr. R. C. Odams (joint hon. secretaries of the Institution of Chemical Engineers), Lt.-Col. F. J. Griffin (general secretary, S.C.I.), Dr. H. J. T. Ellingham (secretary and registrar, Royal Institute of Chemistry), Dr. E. H. T. Hoblyn (director, British Chemical Plant Manufacturers' Association) and Dr. J. B. Brennan (general secretary, Institution of Chemical Engineers).

The toast of 'Our Guests' was proposed by the chairman of the Group, Mr. G. Brearley, who also presided at the annual general meeting of the Group, held prior to the dinner.

At this meeting a gratifying increase in membership, which was 781 at the end of 1955, compared with 669 at the end of 1954, was recorded. The chairman paid tribute to Mr. R. C. Odams at the end of his term of 5½ years as hon. secretary of the Group. Officers for the year 1956-57 were elected as follows: *chairman*, Mr. G. Brearley; *hon. secretary*, Mr. J. L. Sweeten; *hon. treasurer*, Mr. F. A. Greene; *hon. editor*, Mr. D. M. Wilson; *hon. recorder*, Mr. H. W. Thorp.

British Patent Claims

The following are abstracts of some recent British patents which will be of interest to our readers. These abstracts are reproduced from the weekly Patents Abstracts Journal *by permission of the Technical Information Co. The complete specifications can be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, price 3s. each.*

Furnace heating installation

A wide-range burner, of the type in which liquid fuel feed pressure is maintained at full value up to the nozzle tip, has its fuel control mechanically linked with the air control member of an air supply of wide range which maintains air supply pressure up to the combustion zone, so that a single operating member actuates both controls for correct relation through a wide range of fuel feeds.—747,523, *Shell Refining & Marketing Co. Ltd.*

Centrifugal separator

A centrifugal separator, designed for separation of liquids (*e.g.* rubber latex) having a sticky lighter component, is provided with bowl discs, the position of which is determined by ribs on the outside of a central distributor, and between which the sticky component during separation is led inwards towards the centre of the separation chamber in order to be discharged therefrom. The ribs are designed as bars which over a major part of their length are spaced from the distributor, so that a substantially uninterrupted sliding space is formed between the ribs and the outside of the distributor.—747,329, *Akt. Separator* (*Sweden*).

Reclaiming of rubber

Rubber crumb is mixed with a reclaiming oil and mechanically worked at an elevated temperature below the decomposition point of the rubber in the presence of an ester of a monobasic organic acid and a polyglycol or a salt of a monobasic organic acid and a quarternary ammonium compound. —744,917, *Semtex Ltd.*

Cold separation of air

In a process for the production of liquid O_2 at a constant rate by the liquefaction and rectification of air, in which liquid nitrogen is used as reflux liquid in the rectification stage, liquid oxygen being subsequently vaporised to a high pressure by heat exchange with the process stream, excess cold recovered in the oxygen vaporisation is used to produce a reserve of liquid N_2 which augments the N_2 reflux in the rectification step when insufficient cold is produced on vaporisation.—747,298, *British Oxygen Co. Ltd.*

Mixing machine

In a machine in which a continuous worm is located near the inlet portion of the machine and feeds material (*e.g.* cellulose undergoing esterification) to an interrupted worm which co-operates with ribs on the casing (the latter being reciprocated longitudinally relative to the interrupted worm), such continuous worm is not integral with its driving shaft, and is not reciprocated (*cf.* Brit. Pat. 626,027). —747,445, *Soc. Rhodiaceta* (*France*).

Separation of gases

Continuous fractional absorption method for separating two gases of closely adjacent boiling point using a selective solvent in which the solvent is completely stripped of the more soluble component by the less-soluble gas and then recycled to the top of the column (*e.g.* for butadiene/butylene mixtures).—747,411, *Montecatini Soc. Generale per l'Industria Mineraria e Chimica* (*Italy*).

Manufacture of synthesis gas

A solid, liquid or gaseous fuel is incompletely burnt with air with or without steam and/or CO_2 to generate producer gas containing 40 to 75% of CO_2 and N_2 and, after removal of CO_2, dust and S compounds, the gas is fractionated and the gases so obtained under pressure are expanded to provide cooling and power for the process. —744,857, *M. Steinschlaeger.*

Recovery of sulphuric acid from iron sulphate

Single-stage, direct conversion of iron sulphate into sulphuric acid and iron oxide (*e.g.* regeneration of exhausted acid pickling solutions), by heating the iron sulphate to $<600°C$. in the presence of water vapour and an oxydising agent, in a chamber devoid of air; *cf.* Brit. Pat. 425,291.—744,708, *W. Fackert* (*Germany*).

Production of sulphur

A gaseous stream containing $<13\frac{1}{3}\%$ by volume of SO_2 and $<26\frac{2}{3}\%$ of H_2S is passed through a catalyst bed in a reaction chamber under such conditions that deposition of S on the catalyst is avoided. Elemental S is recovered from the gaseous reaction products.—744,908, *American Smelting & Refining Co.* (*U.S.*).

Graphite apparatus for cooling, absorption, etc.

Cooling, condensing or absorption columns for corrosive fluids consisting of lenticular or plate-shaped hollow elements connected by through-bored nipples, and so arranged that an annular trough is formed within the lower part of each lenticular element, in which liquid flowing down the inside walls of the column can accumulate, thus increasing the duration of liquid in the apparatus.—747,473, *Dynamit-A.G., vorm. A. Nobel & Co.* (*Germany*).

Welding of irradiated polymers

Polymers of increased resistance to solvent action and cold drawing, obtained by irradiation (*cf*, Brit. Pats. 732,047 and 737,709), are welded together by interposing polymer of the same composition which has received less ionising radiation and subjecting the whole to pressure at a raised temperature.—747,474, *United Kingdom Atomic Energy Authority.*

Dispersion of inorganic materials in metals

Dispersion is achieved by using a substance capable of lowering the interfacial tension between the solid inorganic material and the molten metal and comprising Na, K, Cs, Li, Mg, Ca, Sr, Ba or their compounds (except the fused halides).—747,471, *G. Imich* (*France*).

Ferrochromium recovery

Production of ferrochromium products of controlled carbon content by smelting a chromite ore charge in a three-phase, submerged arc, electric furnace in the presence of sufficient carbon to reduce all the Fe and $>80\%$ of the Cr present, introducing the molten product (*i.e.* metal and oxide slag) into an arc electric furnace and reducing the oxide in the slag to Cr by fluxing with a reducing agent.—747,496, *M. J. Udy* (*U.S.*).

Aromatic dicarboxylic acids

Toluene is alkylated with olefines having up to 12 C atoms per mol; the monoalkyl toluene is fractionally distilled from the product and oxydised at $>120°C$. by direct contact with an O_2-containing gas until benzene dicarbosylic acids and fatty acids are formed. The oxidation product is treated for the separate recovery of such acids. Particularly applicable to the production of terephtalic acid; *cf.* Brit. Pat. 633,985.—744,746 and 744,809, *British Petroleum Co. Ltd.*

WHAT'S NEWS about

★ Plant
★ Equipment
★ Materials
★ Processes

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Temperature control

A temperature control unit has been designed for the accurate control of the temperature of platens, ovens, rooms, containers, liquids, gases, etc. It enables any temperature over the very wide range –96 to 428°C. to be maintained constant to within 0.3°C. and employs a circuit which is claimed to be both dependable and extremely versatile in operation.

The versatility of the equipment is mainly due to the incorporation of two output relays which operate at slightly different temperatures. This arrangement provides means of controlling any heating or cooling process employing motor-controlled diaphragm valves, such as are used for steam, oil, fire or gas heating, or motor-controlled dampers and draught-control apparatus on solid-fuel boilers. It also enables coarse and fine electric heating elements to be employed for applications where quick heating is essential.

CPE 267

Non-destructive test set

Equipment is available with applications ranging from the measurement of the viscosity of opaque liquids, as in the oil, paint, chemical and food industries, to detecting faults in metal bars.

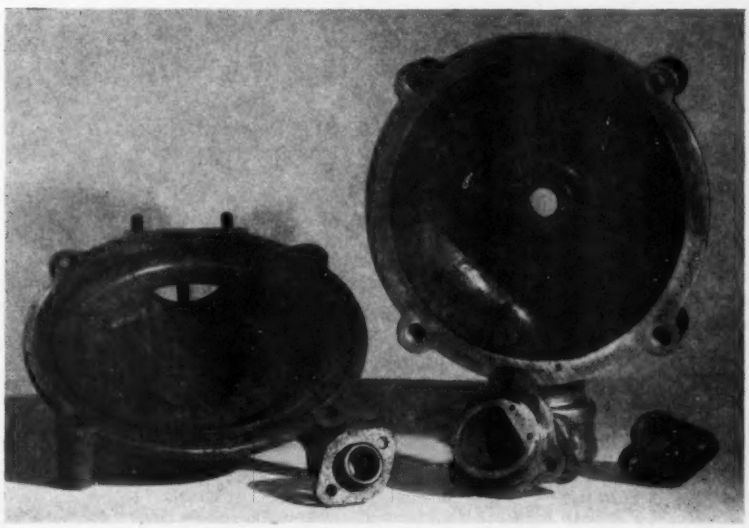
The following advantages are claimed: (*a*) it will locate internal and surface flaws in ferrous and non-ferrous tubes, extrusions, castings, bars and pressings; (*b*) it will test, against a standard, ball and roller bearings for cracks and flaws and metal-clad armature relays for annealing faults; (*c*) there is a wide use for it in the electrical engineering industry; (*d*) it can be used for metal stock control and examination and ensure that faultless material is issued by stores before expensive machining and processing takes place; (*e*) it will test hardness against a standard and will sort annealed from unannealed material; (*f*) for viscosity testing, it will accurately locate the descending ball bearing in the Stokes test for viscosity (it is no longer necessary to be able to see the ball bearing at any time after its immersion in an opaque liquid); and (*g*) it will locate concealed welds, magnetic particles in non-magnetic materials and non-metallic inclusions in metals. **CPE 268**

Plastic coatings applied to metal

Industrial application of plastics has been limited hitherto by the fact that engineers have often found that these materials did not have sufficient physical strength to meet their requirements. Plastic coatings on to metal, however, open up a completely new approach to the problem. It is now possible for metals which have the physical strength but not the corrosion, abrasion or low frictional resistance which is needed to be coated with suitable plastics.

It is, therefore, possible to make what would normally be costly fabrications in comparatively cheap metals and coat them with a plastic which will not only be more economical than the use of costly alloys, but will have an improved life.

Polythene, nylon, PVC and PTFE are the materials most commonly used,



Plastic coating applied to pump components (see text)

C.P.E.'S MONTHLY REPORT AND READER SERVICE

and each of these has its own particular advantages for given applications. The base metal is treated to give the coating strong adhesion, and processing temperatures are low enough to ensure that there is practically no likelihood of distortion of the metal base. Exhaustive tests under working conditions have shown that the coatings have a ready acceptance in industry both for new and existing installations.

The photograph shows a pump which has been internally coated with nylon. Lubrication at the bottom bushes has been eliminated and the life increased. **CPE 269**

Paint stripper for epoxy-based coatings

A chemical stripper specially designed to strip cold and low-temperature stoved types of epoxy-based paints has been introduced to the market. Thus it is now possible to strip, by chemical means, paints that have hitherto proved 'unstrippable.'

The makers point out that among the properties of epoxy-based coatings are their extraordinarily high resistance to chemicals and even to some of the most powerful solvents. Normal types of paint stripper therefore have no effect on them. However, it is stated that, after brushing *Epistrip* on to the surface and it is allowed to remain for some 10 to 15 min., the paint can be removed easily by a knife, scraper, wire brush or other simple means.

The surface does not have to be degreased after the paint has been removed; washing down with cold water is sufficient.

The stripper works on vertical as well as on horizontal surfaces. It is not suitable for use on *high*-temperature stoved epoxy-based coatings.

CPE 270

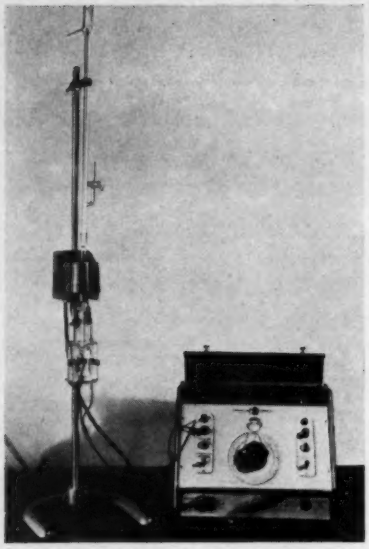
Automatic laboratories

The immediate applications of *Analmatic* are likely to be found in process control laboratories and large industrial laboratories where repeated analyses of a standard type are being carried out.

According to the makers, *Analmatic* laboratories are likely to be of particular benefit in refineries, sewage works, solvent recovery plants, the recovery of precious metals and expensive chemical compounds from large-scale production plants, hospital laboratories engaged in routine analysis, the control of the various stages in the production of pharmaceuticals, testing the characteristics of chemical products, petroleum testing and gas analyses. Whilst the technique of *Analmatic* is at present being applied to chemical analysis, the general principles upon which the instrument has been designed make it possible to extend its applications outside this field.

The *Analmatic* is based on a unit system of construction in which individual units are each arranged to carry out a specific laboratory task. Other units are intended for controlling the order and performance of such tasks and recording the results. To form a complete automatic laboratory, selected units are mounted together in a standardised cabinet and interconnected as required electrically and otherwise in such a manner that a technique previously detailed by the customer is carried out without human intervention (other than for occasional maintenance). Therefore, although a complete equipment may consist of a number of standardised units, the whole assembly is, in fact, tailored to the customer's individual needs.

CPE 272



AUTOMATIC TITRIMETER

This versatile analytical instrument, which was recently shown in its latest production form, is stated to be capable of carrying out a volumetric titration automatically and to an accuracy comparable with manual operation. Provision is made for two titration units to be used independently and both volumetric and coulometric systems are available. **CPE 271**

HIGH-ALLOY CASTINGS

As the result of considerable research, and in conjunction with a special casting technique, high-alloy castings are now being produced which, the makers state, are suitable for most severe and exacting operating conditions encountered in industry.

These *Endewrance* castings give good service life under conditions of heat, abrasion, corrosion and erosion, and can be supplied 'as cast' or machined to customers' individual requirements. They are available in a number of compositions. **CPE 273**

Fraction collector

An automatic fraction collector for column chromatography consists of three main sections: the base and power unit, the collector plate, and the fraction measuring device. The base is a stove-enamelled casting fitted with levelling screws, a spirit level and a support rod. The power unit is enclosed in an enamelled aluminium spinning and the controls consist of a mains switch and indicator light and a push-button release for the collector plate.

The collector plate, which is available in four sizes (100 × 3 ml. collection tubes, 84 × 10 ml. tubes, 54 × 25 ml. tubes and 44 × 50 ml. tubes), is constructed of chromium-plated brass spinnings. It is pivoted from the base and is rotated by a spring drive, the movement being controlled by an electrically operated ratchet mechanism. Each plate has one collecting position in excess of the number quoted. The tube in this position is intended to be connected to a reservoir so that, if the apparatus is left unattended and the cycle of collection be completed, the excess effluent can be collected.

The fraction measuring device, which is the most important part of the instrument, consists of a beam pivoted on a boss mounted on the main support rod. The beam carries an automatic measuring syphon tube at one end and adjustable counterweight at the other. Effluent drips into the measure, which discharges definite volumes of liquid through a funnel held by a bracket mounted on the support rod into the collecting tubes. The beam is adjusted to balance with the measure half full. The measure rises to its maximum height

when empty and moves to its lowest position when full. The beam controls a mercury switch which operates the collection plate release mechanism by an impulse through a relay, and the plate advances one position each time the measure discharges, but the movement is delayed until the measure is half filled again so that drainage errors are eliminated, it is claimed.

CPE 274

Carboy truck

A new truck recently exhibited in London is a development of the *Safe-Way* carboy tilter in which the sliding clamp does not touch the iron skip, there is no metal ring surrounding the neck of the bottle and there is no chain or bar across the front of the carboy.

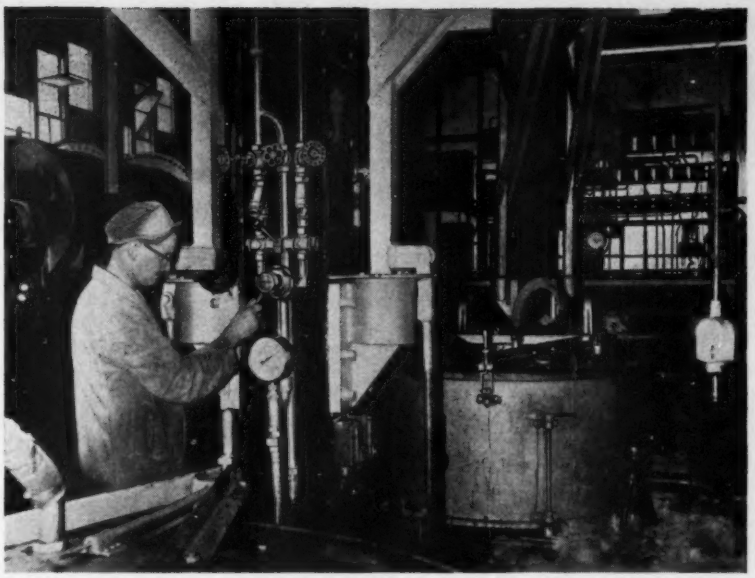
In the case of the carboy truck, the full carboy is placed in the cradle at ground level and, by means of an easy arm and foot operation, the carboy is immediately lifted to the transporting position.

An ingenious lever-operated 'stop' can be put out of operation when lifting the carboy from the ground or lowering it when empty. After lifting the carboy a single movement of the ball-handled lever puts the 'stop' into action and the carboy is then ready for transporting to any place and for emptying by pulling on the tilting handle. It will be noticed that the carboy is lifted to a sufficient height to ensure complete emptying.

This new truck is available with large 14-in.-diam. wheels, either all steel or rubber cushion tyred.

CPE 275

Carboy truck being operated.



Thermostatic steam and water mixing valve serving jacketed pans at a glue works in the United Kingdom.

Thermostatic mixing valves

Thermostatic mixing valves are being marketed which are claimed to provide a cheap and effective means of controlling the temperature of the water fed to jacketed vessels. One of these valves, fitted in a system of such vessels—whether on open or closed circuit—will under average conditions automatically maintain the temperature of the water within close limits irrespective of reasonable fluctuations in the temperature or pressure of the supply of hot water or steam.

This type of valve incorporates a thermostat consisting of a bimetallic coil which, expanding or contracting in accordance with the changes in the temperature of the water, moves a sleeve which opens or closes the ports through which the cold and hot water (or steam) supplies pass into a mixing chamber. Should either supply fail, the thermostat immediately closes against the other supply.

These thermostatic valves are stated to be equally as effective in operation with a battery of vessels as with a single one and will feed heating coils instead of jackets. The maximum operating economy is obtained with a recirculating system, the make up of steam entering the system being usually in the region of 1 to 2%. The makers state that the cost of equipping a new installation with this system of temperature control is comparatively small and that, when an existing plant is converted to it, the cost is almost negligible.

CPE 276

Rubber accelerator

A new delayed-action accelerator developed in the United States will be of special interest to tyre manufacturers and others who encounter severe scorching problems in processing. This rubber processing chemical, known as *Dibs*, was specifically developed to encounter the high processing temperatures built up during the mixing and extruding of super-abrasion furnace black stocks. The small particle size of these carbon blacks imparts extreme abrasion resistance and makes them valuable in longer-wearing tyre treads, industrial belts, tank blocks and other mechanical goods where resistance to severe service is important.

The accelerator consists of N, N-diisopropyl benzothiazole-2-sulphenamide. Its melting range of 131 to 139°F. permits easy incorporation into furnace black stocks. *Dibs* has good storage stability under normal temperature conditions.

CPE 277

Colloid mill for high-frequency dispersing

The high cost, complexity and comparative frailness of high-frequency generators of the electronic type have generally retarded the widespread adoption of ultrasonic techniques. The advent of the *Polytron* system developed in Switzerland is, however, stated to make possible the application of powerful ultrasonic energy to liquid and semi-liquid media.

The equipment consists essentially of a rotor and stator, comprising two shallow coaxial cylinders, the walls of which are formed by rings of specially shaped steel teeth. The outer ring is static, whilst the inner is rotated at high speed by a universal motor, the annular clearance between the rotor and stator teeth being small.

According to the supplier, the design of the system is such that high-frequency vibrations of considerable power are generated. Frequencies up to 240,000 cycles/sec. may be obtained with standard models. The system is claimed to be capable of operation in low viscosities, such as water up to stiff pastes and emulsions. Standard equipment is available up to a motor power of 1.5 kw. suitable for container capacities of 55 gal. The mounting may be in the top or bottom of the tank, autoclave or other vessel. Cutter heads can be fitted for the direct processing of coarse materials in liquid media into finely dispersed suspensions. More powerful motors are available for special purposes.

Smaller portable models suitable for laboratory application are also available.

CPE 278

Thermal insulation calculations simplified

The calculations necessary to determine the economic thickness of thermal insulating materials and the heat loss from insulated surfaces can be extremely tedious. Engineers concerned with this type of work will therefore welcome the introduction of two calculating rules which will enable these calculations to be made with ease and rapidity.

One rule is for determining the economic thickness, for which the following basic data are required:

(*a*) Cost of insulation in pence/sq.ft./in. thickness.
(*b*) Thermal conductivity of insulating material (B.Th.U./in./sq.ft./hr./°F.).
(*c*) Value of the heat to be saved in pence per useful therm.
(*d*) Temperature of the hot surface in °F.
(*e*) Repayment time, *i.e.* the time in which the cost of the insulation can be recovered by the value of the heat saved.
(*f*) Size of the pipe to be insulated (the thickness for a pipe of 12-in. bore used also for flat surfaces and for large cylinders).

The other rule is a heat-loss calculator based on a standard formula.

Full working instructions are provided with each calculator and it will be found that the calculators can be used for multiple-layer as well as single-layer insulation, when calculating economic thicknesses, heat losses and interface temperatures.

CPE 279

Stainless and heat-resisting steels

An interesting range of stainless and heat-resisting steels is offered by a British company. These include nickel-bearing (austenitic) steels, which are unhardenable by heat treatment but work hardenable to a considerable degree. They are non-magnetic and are stated to have a high coefficient of thermal expansion.

There is a standard 18/8 chromium/nickel general-purpose stainless steel, and also a low-carbon version of the same steel, the latter having good weldability without danger of 'weld decay.' Another steel in this range is a low-carbon 19/10 chromium/nickel type, which is described as having good cold-forming properties and as being weldable up to 8 S.W.G. Further nickel-bearing steels include a special cold heading steel for rivets, screws, etc.; a 12/12 chromium/nickel deep drawing quality; and a titanium-bearing standard welding quality.

A further example is a columbium-bearing welding quality, while there are also molybdenum-bearing, acid-resisting steels for use in extremely corrosive conditions.

Among the heat-resisting steels there is one of the 25/16 chromium/nickel variety, used for furnace parts, flame tubes and similar high-temperature parts in gas turbines. The maximum working temperature is 1,150°C. An austenitic heat- and creep-resisting steel (18/8 chromium/nickel with titanium) is for applications up to 850°C., while another (18/12 chromium/nickel with columbium) is used in steam plant as a tube and piping material; this also is suitable for temperatures up to 850°C. **CPE 280**

Power transductors

The possibility of controlling a.c. power with d.c. has been known for many years, but so far no large power transductors have been available to British industry in standard sizes, nor has it been possible to obtain such equipment at short notice.

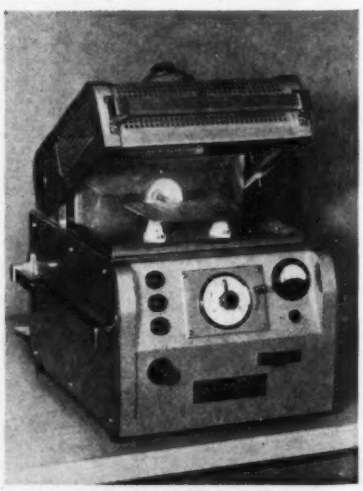
An advantage of power control by means of d.c. is that the d.c. power requirements are only 1 to 2% of the total power involved. A further outstanding feature is the fact that no maintenance is required, as transductors operate without the help of switches, contacts or any other moving parts in the main circuit.

A British firm have now available a standard range in power transductors including units from 10 to 60 kva., single phase, or 30 to 180 kva. when connected in three phase.

The range of current variation is normally 10: 1, but it is also possible to design transductors with wider current ranges for special applications.

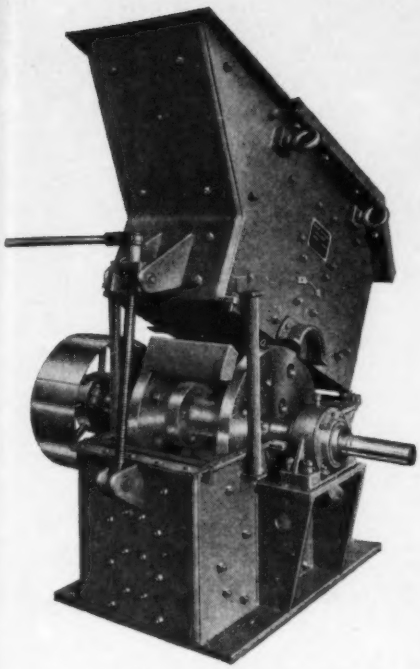
Maximum voltage across the load is 90% of the supply voltage and the current in the d.c. windings can be proportioned to suit requirements.

CPE 281



PRE-HEATER

This high-frequency pre-heater was shown at an exhibition in Germany recently. **CPE 282**



'Lightning' hammer crusher.

Protective garments

Hammer crusher

An interesting hammer crusher is now on the market with a feed aperture capable of accepting relatively large pieces. In dealing with friable materials the feed opening can take lumps up to 10-in. maximum dimension.

The top and bottom casings are fabricated of steel plate and are lined with heavy, renewable, manganese-steel lining plates. Flanges at the sides of the top casing carry the ceiling lining plates which have no bolt heads within the crushing chamber.

The machine incorporates renewable rotor discs, which are attached to the rotor, which consists of alloy-steel disc barrels secured to a machined steel shaft. The rotor is mounted in heavy-duty, self-aligning roller bearings in housings. The crushing hammers are of manganese steel carried upon steel hammer pins, which are protected between the hammer eyes by manganese steel sleeves.

The crusher can be worked either with an open bottom or with screen grids.

Access to the machine is obtained by opening the top casing. A jack, operated by a reversible ratchet spanner, is supplied as an optional extra for this purpose. **CPE 283**

Neoprene boiler suit

A lightweight, neoprene-sprayed-on-nylon-base boiler suit is claimed to give complete protection for the body. This garment was designed and proofed to protect the body from every form of acid, oils, chemical fumes, gasoline, kerosene and radioactive dusts. The *Fury* boiler suit's features are stated to be: (*a*) oil does not affect or crack the neoprene surface; (*b*) it is sewn throughout with *Terylene* thread; (*c*) all seams are specially treated; and (*d*) lightweight material.

In addition, the suit incorporates a double-front fastening (with inside full-length zip and outside stud fastener), and there is double arm and leg covering to fit over gloves and boots, ensuring no leakage. Further features include ventilation at the back and complete freedom of movement. *Perspex* helmets are available in matching materials. **CPE 284**

New oxygen cutting machines

Latest additions to a wide range of oxygen cutting machines now available are the *Bison* and *Beagle*.

The *Bison* will cut steel up to 12-in. thick at a speed of 21 ft./hr. and up to three cutting heads may be fitted so as to give multiple production if required. The *Bison* is a cross-carriage machine and its construction enables bed extensions to be fitted up to any length required.

The *Beagle* is a smaller, transportable machine working on the cross-carriage principle. It has the particular advantage of being able to cut bevels of constant angle, whilst profiling irrespective of the changing radii of the curves. **CPE 285**

Nylon centrifuge tubes

Suddenly to increase in weight from an ounce to nearly a ton places an almost impossible strain on any hollow body. However, new nylon centrifuge tubes now available are claimed to withstand this increase in gravity force. As a result, it is stated, rotation speeds of around 20,000 r.p.m. are now possible in the process of separating fine colloidal solutions.

At these speeds the nylon tubes are supported in close-fitting pockets on an angle rotor and can be spun at a speed of 20,000 r.p.m. The force produced at the extreme tip of the tube is 45,000 times that of gravity. Experience has proved that cellulose acetate tubes tend to distort permanently and glass tubes, in most cases, shatter above 6,000 r.p.m.

These nylon centrifuge tubes are fitted in a refrigerated centrifuge by a British firm. **CPE 286**

New foam fire fighter

A new type of self-contained, portable, foam fire-fighting appliance has recently been announced. It is a trolley-mounted unit of 30-gal. capacity which produces more than 400 gal. of fire-smothering mechanical foam for use against outbreaks involving quantities of oils, spirits, fats and other inflammable materials.

It is claimed that it is particularly suitable for use where water mains do not provide sufficient pressure for other forms of mechanical foam-making equipment, that it can easily be manoeuvred and operated by only one man, and that recharging can be completed on the spot within a few minutes.

A 30-gal. cylindrical tank which comprises the main body of the unit contains a premixed solution of water and foam compound. Discharge pressure is provided by a cylinder of CO_2

gas which is connected to the main container by a short length of flexible high-pressure hose. The CO_2 cylinder is fitted with a sealing disc and a lever-operated piercing head. A syphon tube fitted in the tank is coupled to a 30-ft. length of hose which is carried on a hose saddle clamped to the main container. Foam is generated at the delivery end of the hose by a specially designed miniature foam-making branch pipe. The unit is operated by unwinding the hose and pulling the CO_2 lever in an upward direction. Total discharge is completed in 2 min.

The unit is mounted on a two-wheeled trolley of light, tubular steel construction and is designed to operate in the upright position. The unit weighs 670 lb. when charged, is 4 ft. 11 in. in height and 2 ft. 7 in. in width overall. **CPE 287**

Measuring static electricity

An instrument known as the *Statometer* is used for the detection and measuring of static electricity, which is known for its disturbing qualities in various fabrication processes. For special needs the instrument has been equipped with adaptors so that now measurings are also possible in places which are not easily accessible. Furthermore, the sensitivity of the instrument has been raised. For elimination of static electricity, various equipments have been developed, including an anti-static pistol, the *Self-Corona* ionisator and the *Corona* ionisator. **CPE 288**

Armoured flow indicator

An armoured flow indicator has been recently designed in the U.S. for purge service or flow rate indication of hazardous fluids, at pressures up to 1,500 p.s.i.g. and temperatures to 400°F.

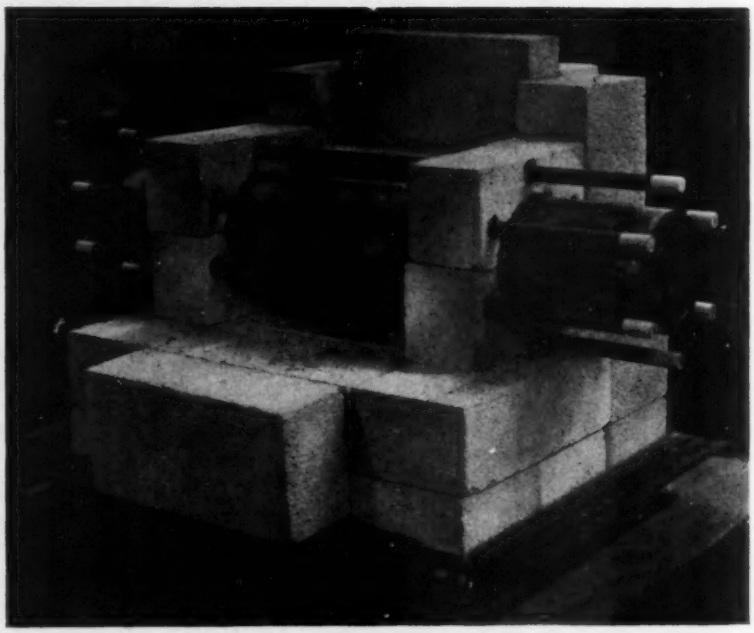
No glass parts come into contact with the metered fluid, and the flow is indicated by a tubular follower magnetically coupled to an extension on a tapered plug in a fixed orifice which measures the flow rate. A positive O-ring seal eliminates stuffing boxes.

Standard flow rates from 1.5 to 180 gal./hr. of water are provided in the single-meter body by five plug and orifice sets. The unit is easily disassembled for cleaning or range change without removal from the pipeline. **CPE 289**

SCREW LIFT

Various types of screw lift are being manufactured in Britain, a screw lift being in principle a vertical screw or worm which runs in a tubular casing, speed of rotation being three times that normally employed in conventional worm conveyors. There are two main classes of screw lift: (a) *gravity-fed machines for elevating granular materials such as grain, nuts, cereals, etc.; and* (b) *horizontal screw-fed machines for the handling of difficult materials such as soft stocks, wet grain, cement, etc. The accompanying illustration shows a typical horizontal-screw-conveyor-fed screw lift.*

Screw lifts are quiet in operation and said to be vibration free, due to the fact that all movement is of a purely rotary nature. It is claimed that they are noted for long-working life between overhauls and trouble-free running. Ball or roller bearings are employed throughout apart from intermediate stabiliser bearings at 10-ft. centres on vertical-screw sections; these are of self-lubricating phosphor-bronze. The gears are of machine-cut carbon steel and run in oil. **CPE 290**



LABORATORY FURNACE

A new type of laboratory furnace has Crusilite *heating elements using silicon carbide resistor tubes which may be run in air up to* 1,550°C. *The resistance is concentrated in a central spiral zone by a helical split.*

The insulating brick used (thermal conductivity 1×10^{-3} *c.g.s.u.) will withstand* 1,540°C. *It may be cut and drilled with normal hand tools.*

CPE 291

Magnetic valve

A new magnetic valve for air, water, light fuel oil and gas is scheduled for production shortly. The valve is pilot operated and provides $\frac{3}{8}$-in. full-bore flow for liquids at pressures up to 150 p.s.i. or gases up to 250 p.s.i. Arranged to open when energised, the valve is fitted with a continuously rated coil and is robustly constructed for industrial use. **CPE 292**

Heat-resistant materials

Silicon carbide and metal-ceramic (*Metamic*) bodies have been developed to operated as from 1,200 to 1,400°C. without deformation and to withstand sudden changes of temperature.

Silicon carbide has good thermal conductivity and is therefore capable of withstanding sudden heating without cracking.

Chromium/alumina and molybdenum/alumina are examples of the introduction of a high-conductivity phase into a low-conductivity refractory to give the same result.

Typical uses for these materials, where resistance to high temperatures and thermal shock are required, include stator nozzles in gas turbines, high-temperature burner nozzles, thermocouple protection sheaths for quick immersion in molten metals, high-temperature brearings, high-duty friction materials, and abrasion- and heat-resistant parts. **CPE 293**

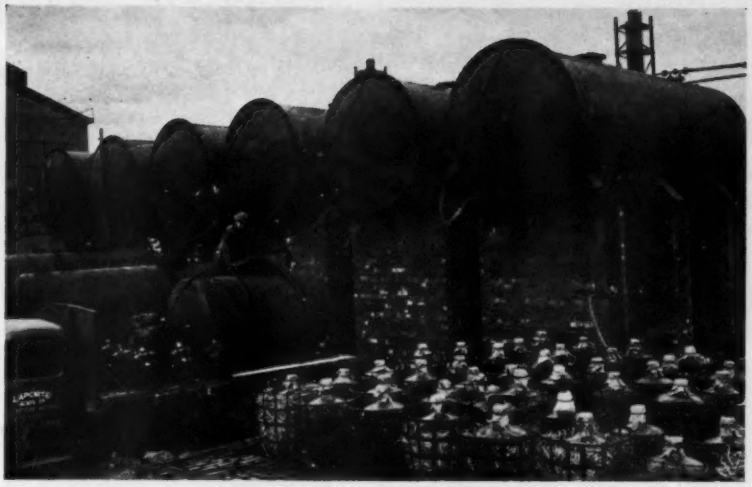
INFINITELY VARIABLE GEAR

A gear which is claimed to provide a practical answer to the problem of stepless speed variation is now on the market. Its design is based on the principle of the transmission of torque through the drag force in a thin film of oil constantly interposed between the driving and driven members, avoiding metal-to-metal contact.

The gear is therefore claimed to be silent and reliable in action, whilst wear is reduced to a negligible minimum. The makers state that mechanical efficiency is remarkably high even at low speeds, and can be expected to reach more than 90% on special applications.

The compactness of the design allows for easy installation in a wide variety of applications.

CPE 294



These storage tanks for hydrochloric acid were lined with rubber ten years ago and are still in service. Each tank holds 5,000 gal. of acid.

Rubber and ebonite coatings

A range of rubber and ebonite linings and coverings on the market is claimed to have applications in every type of industry. Ebonite linings are suitable for use up to temperatures of 65°C. with most chemicals and, under certain circumstances, up to even higher ones. For other purposes rubber is recommended, though a two-ply structure of ebonite and soft rubber can be provided for certain applications. Here the ebonite offers maximum density resistance, while the soft rubber forms a resilient backing to increase impact resistance.

The manufacturers claim that their linings are inseparably bonded to the protected substance and that their use can cut costs up to 25%. When considerations of size or other limiting factors preclude the transport of plant to their factory, the manufacturers are equipped to perform the lining operation at the customer's premises. A team of experienced workers are provided who can accomplish the task with the least possible delay to normal production routines. **CPE 295**

Pre-heater for plastics

A $\frac{3}{4}$-kw. bench plastics pre-heater is available which is claimed to be extremely low in price and which incorporates automatic lid opening. It is claimed that this feature alone can save as much as one operator week per year.

Among the new pre-heater's technical features are the use of xenon rectifiers. It is stated that these rectifiers are for all practical purposes completely insensitive to extremes of temperature.

The new unit will fully plasticise $\frac{1}{2}$ lb./min. of plastic material.

CPE 296

Welding generator

The *Dynex* generator has been specially designed for welding and is suitable not only for d.c. metal arc welding but also for other processes such as argon arc welding. Furthermore, this new generator has been designed so that it is available as a motor generator equipment.

The generator employs a new and unique principle of current control giving infinite current adjustment between maximum and minimum values throughout its entire current range at a practically constant open-circuit voltage. This facility, according to the manufacturers, provides ideal characteristics for modern electrodes and techniques.

When necessary, the open-circuit voltage of the *Dynex* generator can also be infinitely varied between maximum and minimum values to meet the needs of special applications. The machine is twice as fast in voltage recovery as a conventional type of equipment owing to the laminated

construction and special design of its field components. This, it is claimed, results in improved welding facilities, particularly for the welding of special alloys, stainless steel, aluminium and for those applications which involve the use of argon or helium gas screens to protect the weld area from contamination by oxygen or other elements. **CPE 297**

Flame photometer

A flame photometer now on the market consists of a burner (for propane or acetylene) fed with an air supply (conveniently derived from compressed-air bottles) in which the sample material has been finely dispersed by means of a concentric jet atomiser. Light from the burner, which shows a high degree of stability, is passed through a silica prism monochromator of high light-gathering power to a detector via a 100 c/s. chopper.

The detector output is amplified and synchronously rectified, and the resulting signal displayed as a direct reading of emission line intensity on a spot galvanometer having an open scale and high speed of response.

An alternative signal outlet suitable for operating certain standard types of recorder is also provided. A switch selects as a detector either a photomultiplier or a lead sulphide cell.

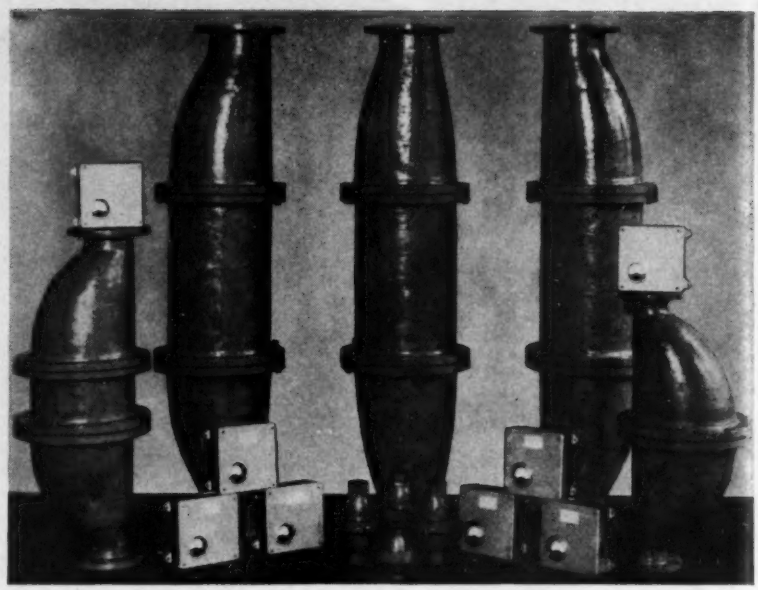
The instrument is constructed in a compact form in which the monochromator is housed in an upper compartment with electronics below, and atomiser at one end in a third compartment.

All controls and the sample input are on the front panel, while the burner is located at the back of the instrument. **CPE 298**

High-frequency welding

High-frequency welding machines, claimed to have a high welding output and a low electric current consumption, have made an appearance recently.

The so-called ' application welding ' offers a number of possibilities where the handling of plastic material is concerned; certain equipment is available for this particular work, equipped with short timers and heating electrodes. Units for up to 2,000 w. are delivered with pedal operation, units for 2,500 w. and more being equipped with electric drive and automatic push-button control. **CPE 299**



' Aquastat ' units—yearly running cost £5 (see text).

Electrical water treatment prevents scale

A number of *Aquastat* units, ordered from a British firm for the Chimbote steel works in Peru, are claimed to represent the largest order that has been placed for electrical water-treatment units to prevent hard water scale, being capable of treating over 5 million gal./day of water. They are to be used to treat the water-cooled electrode glands, furnace doors, reheat furnaces and water-cooled bearings of the rolling mills. Also they are to protect the domestic hot-water service in this steel works.

With such vast quantities of water, treatment for preventing hard water scale has, in the past, often been out of the question owing to the high costs. The *Aquastat* treatment, however, is claimed to be very economical, the yearly running cost of all the units shown in the accompanying photograph being about £5.

The process subjects hardness salts, while they are still in solution, to a minute but carefully controlled electrical force. This neutralises the attraction that the particles of scale-forming salts naturally have for one another. There is a physical but not a chemical change in them, and they remain separated as a fine precipitate. In steam-raising plant this precipitate falls to the bottom as a sludge and is removed by the normal process of blow-down, but where the water is only heated as in calorifiers, hot-water boilers, diesel engines, jackets, etc., it passes through in suspension in the water.

The *Aquastat* unit, as it is called, is compact, is manufactured in a wide range of standard sizes and can be made almost any size to suit requirements. It consists of a pipe unit which is inserted in the pipeline through which all the water passes. A control box mounted adjacent to the pipe unit controls the electrical feed in accordance with the special needs of the process. This control box can be energised from a.c. mains or by its own self-contained dry battery. It is stated that an ordinary $1\frac{1}{2}$-v. bell-ringing type of battery gives a minimum of six months' service. **CPE 300**

Pneumatic process timer

A new pneumatic process timer is now on the market; it is a single unit incorporating a $\frac{1}{4}$-in. B.S.P. or $\frac{1}{2}$-in. B.S.P. five-port valve. There are only two moving parts and the unit will withstand considerable abuse and can be installed in wet or dusty situations and in inflammable atmospheres.

The range is 2 to 60 sec. with an accuracy of $\pm 1\%$, and the timer is intended for use with 80 p.s.i. air line pressure. **CPE 301**

★ Personal Paragraphs ★

★ **Sir Harold Smith,** K.B.E., chairman of the Gas Council, has received the Birmingham Medal—the highest award of the Institution of Gas Engineers. The medal was instituted in 1881 to encourage the extension of the uses of coal gas. It goes to Sir Harold by reason of his distinguished career as a chartered gas engineer and in recognition of his valuable services to the gas industry. Sir Harold, who celebrated his 50th anniversary in the industry on May 2, is only the twentieth recipient of the medal in the 75 years of its existence.

★ At the annual general meeting of the Society of Instrument Technology Ltd., the following were elected to the Council to replace retiring members: *User Group*—**Mr. G. C. Elteneton** (Shell Refining & Marketing Co. Ltd.) and **Mr. R. Riley** (Costain-John Brown Ltd.) *vice* **Mr. P. F. Cook** and **Dr. R. Jackson;** *Manufacturers*—**Mr. R. S. Medlock** (director, George Kent Ltd.) *vice* **Mr. H. R. Walton;** *Education and Research*—**Prof. A. Porter** (Imperial College of Science) *vice* **Dr. G. D. S. MacLellan.**

★ **Mr. H. V. Schofield** has retired from active duties as sales director of the Chloride Electrical Storage Co. Ltd. However, he retains his seat on the board. His retirement from executive duties has involved two new appointments: **Mr. Edward Powell,** director and sales manager of Chloride Batteries Ltd. since 1951, becomes general sales manager of the whole Chloride Electrical group; and **Mr. A. C. Stewart,** who was made assistant sales manager last year, assumes full responsibility as sales manager of Chloride Batteries Ltd.

★ **Mr. J. M. Cannon,** vice-president of Croda Inc. (U.S. associate of Croda Ltd.) and manager of the New York office, is paying a six-week visit to the United Kingdom with his family in July and August. In addition to consultation with colleagues and friends in the trade, Mr. Cannon will be accompanying **Mr. F. A. S. Wood,** managing director, and **Mr. N. Duckels**, works director, of Croda Ltd. on a visit to the new plant of Croda Italiana S.r.L. in Mortara, Italy.

★ **Mr. J. Bruce Miller,** of Aberdeen, who died recently at the age of 89, was for many years associated with Scottish Agricultural Industries (Aberdeen) Ltd. He was the only son of Mr. George Miller who founded the chemical manufacturing works at Aberdeen of John Miller & Co., Sandilands, Aberdeen. He joined the family business in 1889 after studying at Manchester University and working in Edinburgh and London, becoming a partner with his father. He became a director when the Sandilands chemical works were taken over by S.A.I. (Aberdeen) Ltd. He continued as a director of the larger firm.

★ **Dr. W. A. Caldwell,** joint deputy research manager of I.C.I. Ltd., Nobel Division, has become manager of the development department. He joined the department in 1934 and worked on cellulose ethers and other materials, becoming a joint deputy research manager in 1952. **Mr. Wilfrid Taylor,** an assistant research manager since 1945, has become a joint deputy research manager. He has worked on research on electric detonators. **Mr. R. T. Pirie,** head of the method study department, work study department, has accepted a post in Venezuela and has left the company. **Mr. J. E. Forlin,** works superintendent, succeeds him.

★ The sudden death occurred recently of **Mr. Spencer H. Sullivan,** managing director of the Carbon Dioxide Division of the Distillers Co. Ltd.

★ **Mr. T. L. Horabin,** chairman of K.D.G. Instruments Ltd., died recently. He was appointed a director of K.D.G. Instruments Ltd. in 1949 and subsequently became chairman in 1951. He was also a Member of Parliament and was Chief Party Whip for some time for the Liberal Party. He was well known for his forthright and independent views. He was also a well-known figure in the City, and was very keen on painting, which was his hobby.

★ **Mr. John R. Rylands,** who succeeds to the office of president of the Institute of Fuel next October, has had an interesting and varied career as an engineer. His first position after graduating was as assistant electrical engineer to the Taquah & Abosso Gold Mining Co., on the Gold Coast, where he ultimately become chief engineer of the Abosso mine. Whilst there he installed and put into commission the first zinc dust precipitation and extraction plant ever used on the Gold Coast, and erected a 200-v. d.c. transmission line through several miles of West African bush. He also commenced the task of dewatering the flooded Adjah Bippo mine, but before its completion he returned to England to take up the position of assistant engineer to E. Green & Son Ltd., the fuel-economiser makers, in Wakefield. He has devoted the past 32 years of his professional life to the cause of fuel efficiency, and is now chief engineer and a director of the company.

The president (*right*), Mr. John A. Oriel, presenting the Moulton Medal for 1955 to Dr. J. S. Forsyth (*centre*) and Mr. J. T. Wood for their paper 'The Separation of Organic Mixtures by Crystallisation from the Melt,' at the 34th annual corporate meeting of the Institution of Chemical Engineers held in London recently.

World News

GREAT BRITAIN

Uranium from Canada

The United Kingdom Atomic Energy Authority, with the consent of the Government of Canada, has entered into negotiations with Eldorado Mining & Refining Ltd. for the delivery of a substantial quantity of uranium before March 31, 1962. This will represent a major contribution to the supplies of uranium required to meet programmes for which the Authority is responsible.

The proposed arrangement is a continuation of the policy of tripartite co-operation between the U.S., the U.K. and Canada which has existed from the beginning of the atomic energy programme.

Melamine plant extensions

Extension and rebuilding of the Chester-le-Street plant of British Oxygen are being carried out and, when finished, the output will be about 10 million to 12 million lb. p.a.

The site of this factory close to Newcastle was chosen as it was an already developed site near a port and well placed for the main centres of consumption. Dicyandiamide, the raw material for melamine, is imported from Norway.

Albright & Wilson progress

In the manufacture of phosphorus the most important costs are those of electricity and phosphate rock, both of which increased substantially during 1955. Discussing the reasons for this, Mr. K. H. Wilson, in his 1955 statement as chairman of Albright & Wilson Ltd., stated that these factors, and the general rise in wages and prices in the United Kingdom, forced the company to raise its selling prices last September, after maintaining them unchanged for 18 months. He pointed out that, in the short term, cost increases may often be absorbed through higher turnover, but, sooner or later, selling prices must reflect the continuing pressure of inflation on operating margins.

Speaking of Electric Reduction Co. of Canada Ltd., Mr. Wilson said sales and profits of the company increased substantially in 1955. With the completion of the new phosphorus works at Varennes, Quebec, they are now planning a factory for the manufacture of sodium chlorate in Vancouver, B.C., and another factory site has been bought at Hamilton, Ontario.

Humphreys & Glasgow activities

U.K. order. Humphreys & Glasgow Ltd. have been awarded two contracts by the East Midlands Gas Board to build catalytic oil gasification plant utilising the *Onia-Gegi* regenerative process. At Meadow Hall gas works, Sheffield, two units will be erected adjacent to existing water-gas plant, each unit having a daily capacity of 5 million cu. ft. of town gas. The oil gas plant will be used in the first instance only as a standby plant for heavy load periods. At Northampton gas works, the company will erect two oil gasification units, each with a capacity of 3 million cu. ft. of town gas.

Japanese order. From the Osaka Gas Co., Japan, Humphreys & Glasgow have received an order for two large carburetted water-gas plants for the Kyoto works. The installation will have a total daily capacity of 200,000 cu. m. of 470 B.Th.U. gas *i.e.* about 7½ million cu. ft. Heavy oil will normally be used for enrichment and the plant will help to absorb some of Japan's surplus coke. Some of the material will be fabricated to Humphreys & Glasgow design in Tokyo. Special equipment will be supplied from the U.K. The plant will be put into operation in about 16 months.

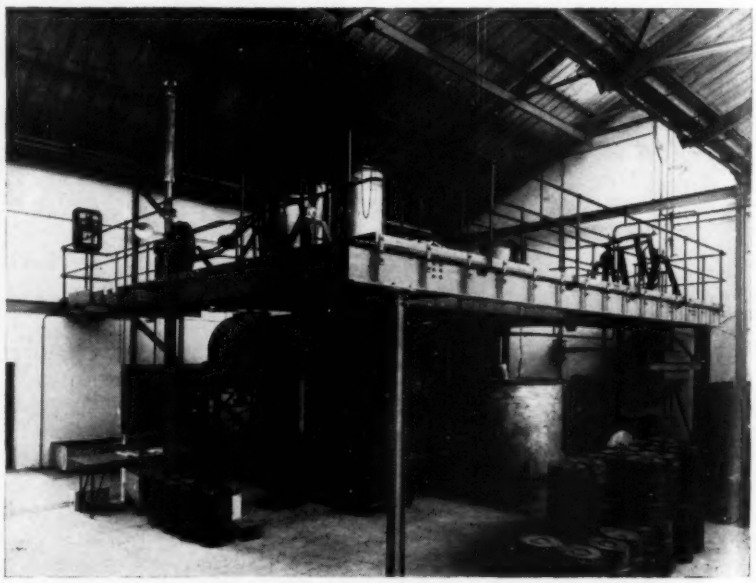
New premises have been constructed at Billericay, Essex, primarily as an equipment and storage depot, but also accommodating bulk storage of the special catalyst used in the *Onia-Gegi* process.

Plant for the manufacture of the catalyst used in this and similar processes is an important feature of the new depot. Before the erection of this plant all catalyst material had to be imported from an associate company in France. Now all plant built by Humphreys & Glasgow in the future will be supplied with catalyst prepared in this depot.

Monsanto looks ahead

Plans for a long-term development in the field of petrochemicals were announced by Mr. E. A. O'Neal, Jun., chairman of Monsanto Chemicals Ltd., in his statement for 1955. He said that, following discussions with Esso Petroleum Co. Ltd., the two companies had reached agreement in principle in respect of an arrangement under which Esso have offered Monsanto a site for a new plant to be erected by Monsanto adjoining their refinery at Fawley in Hampshire (see CHEMICAL & PROCESS ENGINEERING, 1956, **37** (5), 145). As the first operation at this location Monsanto propose to add substantially to their present plastics business by manufacturing polyethylene from supplies of ethylene which will become available from the Esso refinery.

Mr. O'Neal also reported that the company's construction programme, both at Ruabon and Newport, was largely concentrated on new manufacturing plants, with ancillary additions



Catalyst—manufacturing plant of Humphreys & Glasgow Ltd.

to services and power installations. Phthalic anhydride is being considerably expanded in production. The first phase of this expansion has been completed at Ruabon and design work for a major new plant to be constructed at Newport is well advanced.

An expansion of the maleic anhydride recovery plant has been completed at Ruabon, whilst a large plant for its manufacture from benzene is in course of construction at Newport.

Additional plants for chemicals used in the manufacture of rubber products were started up at Ruabon during the year, and cyclo-hexylamine, an important raw material for the company's rubber chemicals group, is to be produced at Newport in a plant now under construction.

Mr. O'Neal also referred to the company's intention to manufacture styrene-butadiene copolymers, now being fulfilled with the construction of a full-scale plant at Newport. Materials from the interim plant are already being supplied for shoe soling and general mechanical mouldings and other specific uses.

'Hydroformer' on stream

A new £4-million *Hydroformer*—the first to be built at a British refinery—is now in operation at the Esso refinery, Fawley. Up till now the main source of high-quality petrol has been the fluid catalytic cracking unit which processes heavy gas oil, but this new unit will produce an even higher-quality petrol by processing the raw petrol obtained in the primary distillation of crude oil. The feed rate will be from 350,000 to 525,000 gal./day.

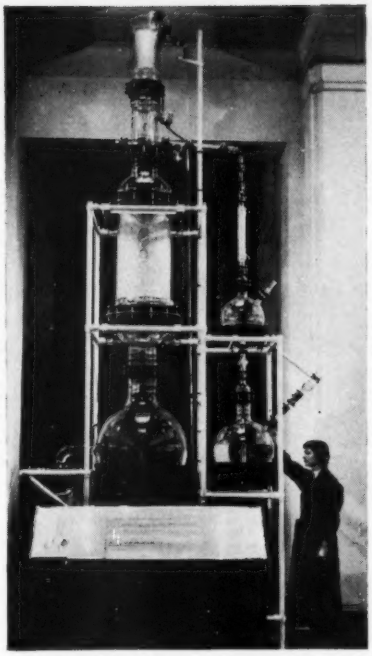
Construction of the *Hydroformer*, which has an overall height of 218 ft., began in March 1955 and was completed in March of this year. Five other plants of this type are at present in existence—in the U.S., Venezuela, the Persian Gulf, Italy and Japan.

Hydroforming is a process in which hydrocarbon vapours are re-formed in the presence of hydrogen. It is the first fully continuous catalytic reforming process.

Kraft paper sacks

Something like a million tons of kraft paper were used in the multi-wall paper sack industry in 1955. The diversity of industries using them was apparent to representatives of the trade and technical press who were invited to inspect the works of William Palfrey Ltd., Rochester, Kent, recently. In various stages of production were sacks for cement, granular superphosphate, hydrated lime, PVC, etc.

The multi-wall sacks are of an almost unlimited size, made up from two to six or even seven layers of kraft paper. Sometimes the sacks are plain kraft paper, multiplied for extra strength, or, quite often, a method of giving one or more of the layers special chemical properties is used. It may be rodent-, pest- or water-proofed, polythene-coated or treated with wax or bitumen, the actual composition of the sacks being settled according to the purchaser's requirements, or on the recommendation of the makers' research laboratory.



DISTILLATION UNIT AT SCIENCE MUSEUM

This picture (no connection with the subject of this month's cartoon on page 219!) shows an all-glass distillation unit of Q.V.F. Ltd., which is the centre-piece of a new display at the Science Museum, South Kensington, to illustrate chemical plant processes.

This unit consists of a 200-litre flask, 15-sq.ft. steam-heated boiler and 18-in.-diam. packed column with reflux ratio head, condensing system and product cooler with twin glass receivers.

Capable of operating under full vacuum, this still is striking evidence of the rapid progress which has been made in recent years in the fabrication of large technical glassware, enabling chemical processes to be completed entirely in glass apparatus.

Plastics conference

A conference is to be held by the British Plastics Federation in Torquay from September 27 to 30 at which papers will be presented on commercial and technical aspects of plastics.

High-nickel alloy fabrication

Henry Wiggin & Co. Ltd. announce that they have purchased the specialised high-nickel alloy fabricating plant at Hereford, which they designed and erected for the Ministry of Supply and have been operating since 1954.

The company is a wholly owned subsidiary of the Mond Nickel Co. Ltd., an affiliate of the International Nickel Co. of Canada Ltd.

Fertiliser plant contract

Matthew Hall & Co. Ltd. have been awarded a £2-million contract in connection with extensions to Imperial Chemical Industries' concentrated fertiliser plant at Billingham, County Durham.

The contract includes the design, procurement and construction work for part of the project, which incorporated the latest techniques in high-grade fertiliser.

Chemical and Petroleum Engineering Exhibition

The organisers of the Chemical and Petroleum Engineering Exhibition, to be held at Olympia, London, from June 18 to 28, 1958, report that such great interest has been shown in the exhibition that the floor area originally available is to be increased by 50%.

The sponsors are the British Chemical Plant Manufacturers Association and the Council of British Manufacturers of Petroleum Equipment.

Ethylene and propylene chemicals

Petrochemicals Ltd., one of the Royal Dutch/Shell group of companies, has started work on an extension to its Partington plant, near Manchester, for the production of ethylene and propylene derivatives. Expected to be in full operation by mid-1958, these new facilities will include a plant for the production of some 25,000 tons p.a. of ethylene oxide. The plant will employ the process worked out by Shell Development Co. in the U.S. for the direct catalytic oxidation of ethylene. A new plant for the conversion of ethylene oxide to ethanolamines came into operation in January of this year and additional capacity for glycol ethers, polyglycols and non-ionic surface-active agents is in course of construction. On completion of the direct oxidation plant the existing ethylene oxide plant will be used to expand the present production of propylene oxide.

To keep pace with the increased capacity, other site facilities such as steam and power generation, cooling water, workshop and stores are also being enlarged.

Ethylene and propylene oxides and their derivatives find wide application throughout industry both in the U.K. and overseas as solvents, plasticisers, detergents, emulsifiers and wetting agents, lubricants and chemical intermediates. Other uses include the preparation of anti-freeze mixtures and anti-static agents, the latter to prevent the build-up of static electricity on synthetic fibre materials.

'Cellofas' plant

A new plant for the production of *Cellofas* in powdered form has been put into use at I.C.I. Ltd., Ardeer. The material was available previously only in fibre form, and the powdered form extends its scope considerably by permitting its use, previously impossible, with other dry materials as a mixture.

The manufactured *Cellofas* is rolled into thin flakes in preparation for drying and milling and is finally passed through a cyclone separator. It is anticipated that the new material will be used extensively in the paint and allied industries.

Symposium on chemical engineering education

A symposium on chemical engineering education will be held at the University, Birmingham, from April 9 to 11, 1957. A number of papers will be presented at four main sessions, covering the views of industry, the universities, technical colleges and schools.

The Institute of Chemical Engineers, Midlands Branch, is organising the symposium. Further details will be announced later.

Electro-plating plastics

At a new factory just opened at Crawley, Sussex, Metachemical Processes Ltd. are commencing production in connection with a new process for electro-plating plastics. Announcing this, the company expresses the belief that the new process will open up a whole field of possibilities for the designers of cars, refrigerators, radio and furniture. In an extreme example of the possible economy claimed for the process, a brass component for a refrigerator was instanced. Chromium-plated, it cost 3s. 10d. In chromium-plated plastics, using the new process, the figure is 1s. 9½d.

'The present methods have the disadvantage that only poor adhesion of the plating is obtained and, in addition, most methods require heavy expenditure of silver,' a spokesman for the company stated. 'Both these disadvantages have been eliminated by the new method, which is secret.'

SOUTH AFRICA

Oil-from-coal plant discussed

By 1965 Sasol will be producing only one-thirtieth of the Union's requirements of liquid fuels, said Dr. F. J. du Toit, chairman of Sasol, in Johannesburg recently. He added: 'If the Union is to become even approximately self-sufficient in this respect we must certainly be planning —if not building—our new Sasols in the next ten years.'

He also said an industrial centre of great magnitude might arise in the Phalaborwa area, with an iron and steel works equal to Iscor (the huge South African undertaking) in production, a copper smelting works, a superphosphate factory, and a supply centre for basic slag.

A capital outlay of not less than £50 million would be needed. By its own efforts the Union was 'less dependent on foreign capital than before, although sound long-term investments from overseas will always be welcome. In spite of local capital formation, more foreign capital is needed.' he said.

The managing director of Sasol, Mr. P. E. Rousseau, said that, in spite of the best consultants in the world, South Africa's £40-million oil-from-coal plant had struck more snags than had been expected. An engineer said that Sasol had two major difficulties: the first was that the plant was one of the most complex pieces of chemical equipment in the world and the second was that Sasolburg was thousands of miles from the sources of plant supply. Delays caused by the failure of some small piece of apparatus to work properly were extended out of all proportion.

Sulphuric acid

The combined annual production of sulphuric acid by African Explosives & Chemical Industries Ltd. factories at Umbogintwini, Somerset West and Modderfontein will soon be equivalent to 400,000 tons of 100% H_2SO_4, according to a booklet issued by the company recently.

JAPAN

Help for Brazilian steel plant

Japan has decided in principle to help Brazil to build a steel plant in the State of Minas Gerais, according to a statement by the Federation of Economic Organisations in Japan.

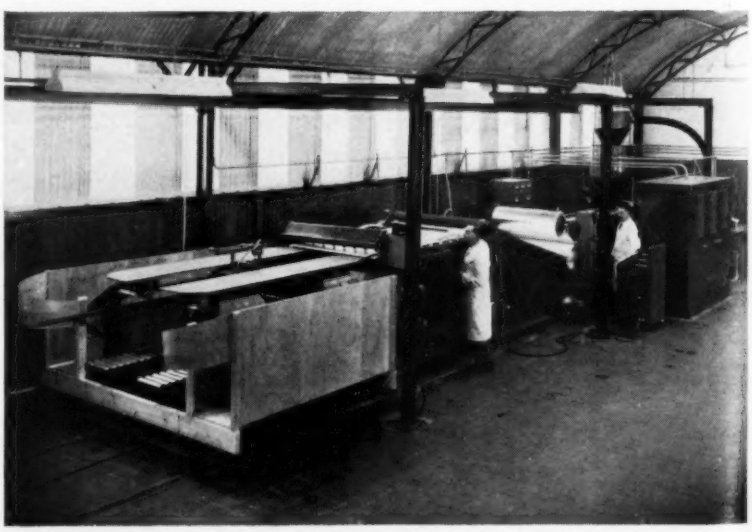
The Federation has said it will appoint a committee to look into the details of the plan, which would involve the supply of 1,700 million cruzeiro of Japanese capital investment, designing of the plant, and technical assistance by Japanese engineers.

FRANCE

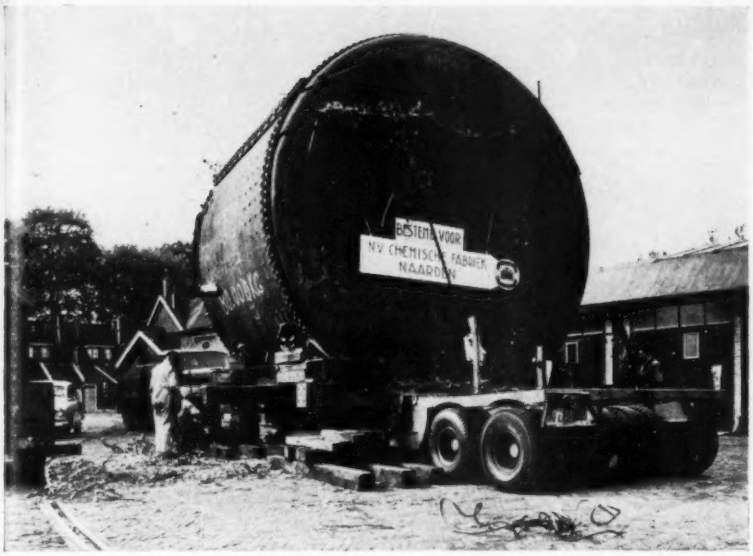
European soap and detergent trends

The working party on soap and detergents of the O.E.E.C. Chemical Products Committee recently met in Paris to prepare a report on trends in this sector in 1955 and the beginning of 1956.

In 12 European countries which in 1954 accounted for 94% of soap production and practically the whole of the production of synthetic detergents in member countries, soap production



The first full-scale plant in the United Kingdom for the extrusion of toughened polystyrene (Styron 475) sheet, installed at Cowes, Isle of Wight, recently, in the works of Saro Laminated Wood Products Ltd.



The 83-ton steam boiler installed at the works of the N.V. Chemische Fabriek 'Naarden' recently, and mentioned on another page.

in 1955, which stood at 1½ million tons, was slightly lower (– 1%) than in the previous year, while the production of synthetic detergents in 1955 was 25% higher and exceeded 700,000 tons.

In these countries the proportion of synthetic detergents used for household purposes varies between 25 and 55%.

No great change is expected in this trend either this year or in the near future.

EGYPT

Aswan fertiliser factory

The National Production Council has accepted the offer of a Franco-German group, comprising the firms Uda, Badische Anilin and Schneider & Kuhlmann, to undertake the construction of the nitrate fertiliser factory at Aswan, which will utilise power from the hydroelectric power station now under construction at the Aswan Dam. The Franco-German offer, including all necessary equipment, machinery and cost of construction, totalled £E12,277,000. The minimum production of the factory is placed at 1,160 tons/day, with a maximum of 1,280 tons.

CHILE

Uranium discovery

The Ministry of Mining announces that 11 deposits of uranium have been discovered in the northern part of Chile. A State company with a capital of 60 million pesos subscribed by the National Development Corporation (C.O.R.F.O.), the Mining Development Bank and the National Smelter Enterprise is being formed for the search and production of uranium.

Iron

The Bethlehem Chile Iron Mines Co. have commenced working their new deposits at Romeral, near La Serena. The ore is being shipped through the newly installed loading port of Guayacan, near Coquimbo. These new deposits take the place of those at El Tofo which have been worked since 1922 and are now almost exhausted.

COLOMBIA

Paper mills

Colombia has awarded contracts for the construction of three paper mills at a total cost of about $30 million to the American firms of Parsons & Whittemore-Lyddon. An announcement said the construction of the mills would enable Colombia to become completely independent of newsprint and white paper imports.

Pulp- and paper-making machinery will be supplied by the Black-Clawson Co., partly from its U.S. factory and partly from its factory in England. Black-Clawson is affiliated with Parsons & Whittemore-Lyddon.

Colombia's Minister of Economic Development announced in Bogota that a newsprint mill of 100 tons/day capacity would be constructed in the State of Cundinamarca, in the Saba de Bogota. It was announced in Bogota at the same time that two mills to produce 50 tons/day of white writing and printing papers and 100 tons/day of bleached paper-making pulp would be erected in the State of Valle Del Cauca, in the region of Cali.

These will be the first newsprint, white paper and pulp mills to be erected in Colombia. They are expected to be in operation by the middle of 1958.

Germans to establish industries

The German Ambassador has announced that a German consortium will open up the coal mines in the Cerrejon area on the Atlantic coast, and establish an export trade and factories making cement, synthetic rubber, plastics and pharmaceuticals.

MEXICO

Fertiliser projects

A fertiliser plant is to be constructed in Monclova, Coahuila, which will use the by-products of the coking industry of that region. The estimated cost of the plant is 156 million pesos, which is being found by joint Mexican-French interests.

A plant for the production of ammonia fertilisers is being built in Guaymas, Sonora, by the local firm Petroquimica S.A. The plant should be operating before the end of 1957 and will cost 75 million pesos.

SYRIA

Salt refinery

The Syrian Government has allocated £S2½ million in a supplementary budget to set up a salt refining factory. The Ministry of Finance has asked the U.N. Technical Assistance Organisation for expert advice on the construction of the factory.

FRENCH WEST AFRICA

Proposed hydroelectric power station and aluminium plant

It has now been decided to proceed with the work of building such a station at Souapiti, in Guinea, and an agreement has been made for the supply of the great amount of capital needed for the completion of the scheme. French firms are putting up some 50% of the capital requirements, Italian, German and Swiss firms are subscribing 30% and a French Canadian firm, which already exploits the bauxite deposits in Guinea, is subscribing 20%. The first step will be the construction of a dam on the Konkure River at Souapiti and the installation of a hydroelectric power station with an annual production of 3,000 million kwh. p.a. The dam will consist of an enormous dyke of compacted earth, 120 m. high with a base of 800 m., requiring some 24 million cu. m. of earth. The hydro-

electric station will be underground and will have four groups of turbines and alternators, each of 100,000 kw.

The erection of the dam and the construction of the hydroelectric power station is the responsibility of the Public Works Department, which is also studying the problem of transporting the metal from the remote site of Souapiti. The two possibilities in view are the construction of a railway to Konakry or the removal of the metal by river.

The aluminium plant for treating the bauxite will be built near the hydroelectric power station, from which its power will be supplied. It will be capable of producing some 200,000 tons of aluminium p.a.

The cost of erecting the dam at Souapiti is estimated at 50 milliards of francs metro. The aluminium plant is to be built before work commences on the stratum of bauxite which is situated 150 km. to the north-east of Konakry. At the same time it is proposed to proceed with the construction of the railway to Konakry for transporting aluminium and to enlarge the port of Konakry. It is probable that work will begin on the dam at Souapiti in 1957 and the production of bauxite for supply of the aluminium plant in the Cameroons about 1960. It is estimated that the aluminium plant at Souapiti will come into full production in 1962-63.

Plastics factory

The first factory for the manufacture of plastics material in French Africa employs 300 workers and is fitted with modern machinery including four electric welding machines. It will treat a monthly total of 20 tons of plastics powder.

ITALY

Fertiliser project

After successfully operating their pilot plant over a trial period, Società Toscana Azoto have decided to erect a full-scale fertiliser plant at Valdarno, some 20 miles south of Florence. The 7,000 tons of ammonia, which have been produced annually since 1953, will be increased next year to 35,000 tons.

In this project Oronzio de Nora have been appointed general contractors, while the engineering will be done in co-operation with the technical staff of Società Toscana Azoto. The order for certain specialised equipment has been placed by de Nora in Germany, but the bulk will be of Italian manufacture. The sulphuric acid plant will be of Monsanto design and will utilise Monsanto catalyst. The rated capacity of the plant will be 100 tons/day of ammonia, 250 tons/day of sulphuric acid and 70 tons/day of nitric acid. On this basis, approximately 100,000 tons of ammonium sulphate with 20 to 21% nitrogen and 40,000 tons of calcium nitrate at 15 to 16% nitrogen are expected to be manufactured annually.

Four to five hundred tons of lignite per day will be transported by aerial ropeway from the mines of Castelnuovo, situated less than three miles from the plant site. The lignite contains some 50% humidity and 15 to 18% ash. It will be broken up and dried so as to contain 8 to 12% water. It will then be gasified at high temperature. The subsequent cost of ammonia is expected to be as low as that produced by natural gas.

The manufacture of fertiliser in Italy is still extremely limited. When at peak production, therefore, this plant should add substantially to Italy's resources.

The Leonard Hill Technical Group—July

Articles appearing in some of our associate journals this month include:

Food Manufacture—Speciality Sugars and their Manufacture; Fish Dehydration—A Warm Air Process; Polyoxyethylene Monostearate in Bread Production; Better Grapefruit Products; Food Production: Complacencies and Facts, 2; Pilot (Glass) Evaporators.

Manufacturing Chemist—Cosmetic Engineering, 2: Serving, Straining, Milling, Filtering; Instrumentation and Works Study, 1; Veterinary Pessaries; Application of Chelating Agents; Progress Reports.

World Crops—A Review of the Nyasaland Tea Industry; *Stylosanthes gracilis* as a Green Crop in Tea; Commercial Selection and Breeding of Tea in India; Cost of Opening up Tea Estates—Expenditure in India, Ceylon and Africa; Developments in Bulgarian Agriculture; Atomic Energy's Contribution to Agriculture; Wheat and Barley Production in Cyprus.

Building Materials—Gypsum in Roofing—Its Insulating and Fire-resisting Qualities; Principles of Domestic Heating; Pre-assembled Units of Fibreboard.

Paint Manufacture—Practical Experience with Thixotropic Alkyds; The Use of Styrenated Alkyds; Resin Round-up; Specialising in Nitro-Cellulose; Instruments for the Paint Industry; The Application of Statistical Methods to the Paint Industry, 2.

Muck Shifter—Samarrah Barrage and Dyke, Iraq; Developments in Dredging; Open-pit Mining of Low-grade Iron Ore; Harnessing the St. Lawrence River.

UNITED STATES

New vinyl chloride plant

The Ethyl Corporation, a producer of anti-knock compounds for engines, is planning to enter the vinyl chloride monomer field with a plant costing several million dollars. This will be constructed at its manufacturing centre at Baton Rouge, Louisiana.

Italian process for rayon industry

Von Kohorn International Corporation, New York, builders and operators of rayon mills, and Oronzio de Nora Impianti Eletrochimici, Milan, Italy, electrochemical engineers, have announced the signing of agreements under which von Kohorn will introduce to the rayon industry the de Nora process for the electrolysis of sodium sulphate.

The de Nora process is said to reduce radically the production cost of all viscose products by recovering both caustic soda and sulphuric acid from the sodium sulphate which is now obtained as a by-product in the rayon industry.

Synthetic-gas-producing unit

Olin Mathieson Chemical Corporation's new experimental unit for the production of synthesis gas by partial oxidation of coal at Morgantown, West Virginia, has been put to work.

Although it will be used for experimental purposes only, the unit will be capable of producing synthesis gas in the amount required to manufacture approximately 80 tons/day of ammonia or equivalent methanol. It is claimed to be the first unit of this size and type that has ever been constructed.

New can soldering process

The American Can Co. has announced a new process of soldering cans—margin plating—that, it claims, will eliminate almost all tin from an estimated 10,000 million cans.

The company expects that the new process—which involves plating only the narrow margins of the steel plate that form the soldered sideseam of the cans—may save as much as 2,600 tons p.a. of tin.

Paper from bamboo timber

The U.S. Agriculture Department is working on the development of a new crop—timber bamboo—which may become a major source of paper supply.

Experiments with the bamboo are being conducted in the south-eastern part of the United States. Experiments so far have demonstrated that bamboo is 'an excellent source' of paper pulp and produces about six times as much cellulose as a pine tree does in an equivalent period of time.